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FEBRUARY 28, 1889.

FORTY-SECOND ANNUAL REPORT

OF THE

TRUSTEES OF THE STATE MUSEUM OF NATURAL HISTORY.

To the Legislature of the State of New York:

I have the honor to transmit herewith the Forty-second Annual Report of the Regents of the University as Trustees of the New York State Museum of Natural History, as required by law.

H. R. PIERSON,

Chancellor.

OFFICE OF THE REGENTS, *February* 25, 1889.

Regents of the University of the State of New York.

EX-OFFICIO.

TRUSTEES OF THE STATE MUSEUM.

HENRY R. PIERSON, LL. D.	*Chancellor.*
GEORGE WILLIAM CURTIS, LL. D.	*Vice-Chancellor.*
DAVID B. HILL, *Governor,*	*Ex-officio Regents.*
EDWARD F. JONES, *Lieutenant-Governor,*	
FREDERICK COOK, *Secretary of State,*	
A. S. DRAPER, *Superintendent of Public Instruction,*	

Elective Regents, in Order of Election by the Legislature.

GEORGE WILLIAM CURTIS, LL. D., 1864	West New Brighton.
FRANCIS KERNAN, LL. D., 1870	Utica.
JOHN L. LEWIS, 1871	Penn Yan.
HENRY R. PIERSON, LL. D., 1872	Albany.
MARTIN I. TOWNSEND, LL. D., 1873	Troy.
REV. ANSON J. UPSON, D. D., LL. D., 1874	Utica.
WILLIAM L. BOSTWICK, 1876	Ithaca.
CHAUNCEY M. DEPEW, LL. D., 1877	New York.
CHARLES E. FITCH, 1877	Rochester.
REV. ORRIS H. WARREN, D. D., 1877	Syracuse.
LESLIE W. RUSSELL, LL. D., 1878	Canton.
WHITELAW REID, 1878	New York.
WILLIAM H. WATSON, M. D., 1881	Utica.
HENRY E. TURNER, 1881	Lowville.
ST. CLAIR MCKELWAY, 1883	Brooklyn.
HAMILTON HARRIS, 1885	Albany.
DANIEL BEACH, 1885	Watkins.
WILLARD A. COBB, 1886	Lockport.
CARROLL E. SMITH, 1888	Syracuse.
MELVIL DEWEY, *Secretary*	Albany.
ALBERT B. WATKINS, Ph. D., *Assistant Secretary,*	Albany.

Museum Staff.

JAMES HALL, LL. D.	*Director.*
JOHN C. SMOCK	*Assistant-in-charge.*
CHARLES E. BEECHER	*Consulting Palæontologist.*
WILLIAM B. MARSHALL	*Assistant Zoölogist.*

JAMES HALL, LL. D.	*State Geologist.*
J. A. LINTNER, Ph. D.	*State Entomologist.*
CHARLES H. PECK	*State Botanist.*

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REPORT OF THE TRUSTEES.

To the Legislature of the State of New York:

The Regents of the University, as trustees of the State Museum of Natural History, submit to you, as required by law, their forty-second annual report.

For full information concerning the details of the different departments of the Museum, reference is here made to the reports of the Director and Assistant Smock, who is the assistant-in-charge of the State Museum, and the reports of the State Botanist, and the State Entomologist, and the State Geologist. From these reports, it will be seen that very material progress has been made in the legitimate work of the Museum, and in the accumulation of specimens appropriated for the Museum. The minerals especially, which last year had received a very important addition from the collection purchased from Mr. George F. Kunz, has been, during the past year, still further increased. It is now fairly to be considered one of the most important, as well as beautiful, collections in the State. Both in the minerals and in the other collections of the Museum, the effort has constantly been kept in mind to restrict the specimens, as far as possible, to the territory of the State itself. For the purposes of comparison, however, the collections frequently are carried beyond the boundaries of the State itself, and this has been done to some extent in the department of Mineralogy.

The Zoölogical collections have been also materially improved during the past year. The purchase of a number of good specimens and the repair of the specimens already on hand have greatly increased the value of these collections.

Important additions to the collections in Palæontology have also been procured, which especially we desire to mention in this connection the collection of "tracks" found in the neighborhood of Port Henry. One of the most interesting of these specimens was laid in the sidewalk of Port Henry, as a part of the pavement. This attracted the attention of Professor Smock, who made efforts

not only to obtain this stone from the pavement, but also others of the same kind which might still be found in the quarry from which this was dug. In this way a large collection of specimens, making in all almost a carload, have been procured and received at the Museum.

Director Hall has also procured from various sources in the west and southwest of the country, specimens which he proposes to make use of in preparing for publication the last volume of Palæontology.

According to the law passed in 1883, the last volume of the series in Palæontology should have been published during the present year. But various circumstances have delayed this publication and it can not be issued until some time during the next calendar year [1890]. In the report of the State Geologist, which is appended to this report, a full account will be given of the condition of the material and of the prospects of publication. The most serious circumstance attending this publication is that the sum of money appropriated for the publication will not suffice to make it on the scale originally designed. If the cost is kept within the bounds of the money appropriated, then the last volume must be made materially smaller than was intended.

Upon a full consideration of the questions involved, the local Museum committee came to the following conclusion in reference to this matter: "A sum sufficient to prepare and deliver a volume on the Palæontology within the limits of the appropriation, is to be reserved and kept intact; at the same time the appropriation is to go on for a volume of the size and plan originally fixed. The subject is thus to be presented to the Legislature, with a statement of the circumstances attending the publication, namely, that the sum appropriated in accordance with the original bill of 1883, has not been found sufficient to publish the work as thus planned; that the trustees have, however, reserved a fund sufficient to publish a volume smaller than the preceding ones, and in this way to complete the publication. The trustees, however, think that it is advisable to make the remaining volume of the form and size originally designed, and they propose, therefore, to submit to the Legislature the question of the appropriation of an additional sum, which shall, when added to the balance now available, be sufficient to publish and complete a suitable final volume."

By chapter 206, Laws of 1888, the Superintendent of Public Buildings was required to furnish to the Grand Army of the Republic, a suitable room or rooms for the preservation of its records, and for the establishment of a central office. In pursuance of this law, the trustees of the Museum were requested to surrender one of the rooms which they were in possession of in the State Hall. This room was not essential to the uses of the Museum until the entire building could be surrendered to the trustees for that purpose. Under these circumstances, the trustees did not feel that they could consistently refuse to grant this room to the Grand Army of the Republic, until such time that the Museum would be in a position to make use of it. The room, therefore, on the second floor at the southwest corner of the building, has been given up to the Grand Army of the Republic, and is now in their possession.

No progress has been made during the past year in transferring the Museum to the State Hall. The condition affixed to the original law, namely, that the Museum should have possession of the rooms when they were vacated by the State officers, has, during the past year, been fulfilled in no further degree than before. The Comptroller and Treasurer, and the State Engineer and Surveyor, and the State Board of Charities still occupy rooms there. And it appears now, as the New Capitol approaches completion, that these State officers will continue to occupy the rooms which they now hold in the State Hall. If this is the case, then the plan, which originally was thought feasible, falls to the ground. The State Hall can not be made use of for the collections of the Museum. It, therefore, becomes a very pressing and serious matter to make some other provision for the collections now in the State Museum. The building in which the Museum is chiefly established is not fire-proof, and nothing will prevent the entire destruction of the invaluable collections which are now gathered there. We recommend, therefore, that early and serious attention be given to this subject. As the Trustees of the Museum, which is the property of the State, we do not feel content to allow the trust which has been bestowed upon us to remain in this dangerous condition.

During the past year several bulletins have been published. It will be remembered that Bulletin No. 2 was issued by the Museum during the year 1887. It is entitled "Contributions to the Botany of the State of New York," by Charles H. Peck, State

Botanist. Bulletin No. 3 was published in March, 1888, and is entitled, "Building Stone in the State of New York," by John C. Smock. Bulletin No. 5 was issued in November, 1888, and is entitled, "The White Grub of the May Beetle," by J. A. Lintner, Ph. D., State Entomologist. Bulletin No. 6 was also issued in November, 1888, and is entitled, "Cut Worms," by J. A. Lintner, Ph. D., State Entomologist. Bulletin No. 1 has not yet been issued. It is to be on the subject of "Spongidæ," by James Hall, Director. Bulletin No. 4 is now in the process of printing, and will be issued in a few weeks. It is upon the subject of minerals collected in the State Museum by Mr. Nason, who spent some time upon a careful study and arrangement of the minerals in the Museum, and has compiled this bulletin in consequence of his labors.

A proposition is now under consideration to transfer the Museum library to the care of the State Library. If there were a building sufficiently large for all the purposes of the Museum, then there would be a propriety in keeping the Museum library in connection with the specimens. But at present this is not the case, and the library is in part kept at the old Museum building on State street, and in part at the State Hall. The staff of the Museum, therefore, are required to go from the one to the other of these buildings very frequently, in order to obtain the advantage of the books in the library. There would be no greater inconvenience in placing the books in the Capitol in connection with the State Library. There the staff of the Museum would find the books ready for their consultation. There are besides in the State Library very many scientific books. These, when put with the scientific books of the Museum, would make a much larger and better collection than can be now found in either of the libraries. Very many of the important scientific societies who publish valuable scientific serials object very naturally to sending copies of their publications to two libraries situated in the same place. This objection has been actually made within a few months, and it is a very natural and proper one. The Regents practice the same system in distributing the State publications that are committed to them. They do not feel themselves called upon to put these donations from the State in two libraries in the same city. If the Museum library were transferred to the State Library, then, of course, this objection would fall to the ground. The books now in the Museum library should

have greater care bestowed upon them than is possible now, and would therefore be in a better condition both as to natural increase, and also to the usefulness and preservation of the books.

Plans have been arranged for furnishing to the State Museum a collection of native woods of the State of New York. It is estimated that about seventy-five different specimens would be required to represent fairly the timbers that grow to the full size of trees in the State of New York. It is proposed that large specimens showing the bark, the grain in different positions and the susceptibility to receiving polish shall be shown in these specimens. Negotiations are now in progress with Mr. Romeyn B. Hough, of Lowville, N. Y., to furnish the specimens that would be required for this collection

Before closing the report, it is proper to mention that Mr. Charles E. Beecher, who was for a long time in the employ of the State Museum, has, during the past year, gone to the Yale College museum as assistant in "invertebrate" palæontology. He has, however, been retained in his connection with the State Museum, as Consulting Palæontologist, and visits the Museum once every month, giving such time and assistance to its operations as he may find possible and necessary.

The rest of the Museum staff remains in the same condition as at the last report: James Hall, LL. D., Director; John C. Smock, Assistant-in-charge; William B. Marshall, Assistant; Charles E. Beecher, Consulting Palæontologist; Charles H. Peck, State Botanist; J. A. Lintner, State Entomologist.

Respectfully submitted.

H. R. PIERSON,

Chancellor.

December, 1888.

STATE MUSEUM

OF

NATURAL HISTORY.

REPORT OF THE DIRECTOR.

REPORT OF THE DIRECTOR.

ALBANY, *December* 4, 1888.

To the Honorable the Board of Regents of the University of the State of New York:

GENTLEMEN.— According to the requirements of the law organizing the State Museum, I beg leave herewith to communicate my annual report (being the forty-second in consecutive order) upon the condition of the collections in the several departments as far as the same have come under my knowledge or direction; also a statement of the additions made thereto, and the work done in the Museum proper during the past year.

The last preceding annual report has already been printed and delivered.

The accompanying communication from Professor Smock contains a full and detailed account of the operations of the Museum during the past year under the heads of current work, arrangement and rearrangement of collections. Full lists of the additions to the collections in the several departments of Botany, Zoölogy, Mineralogy and Geology, and to the Library. It is therefore unnecessary for me to enlarge upon this record.*

In the report of the Geologist it will be necessary to make reference to some of the lists of specimens here presented, since they were expressly collected, or otherwise contributed, or purchased for the use in vol. VIII of the Palæontology of the State.

Owing to my constant occupation in collecting and preparing material for the completion of the volume upon the Brachiopoda, I have been unable to devote any time to matters specially connected with the current work of the Museum. The collections of fossils, however, and the arrangement of the same for study and illustration, although done in preparation for the Palæontology, do become of the highest importance to the Museum collections, since they show the result of special labor and investigation, and

* These lists are published as they came from the assistant in charge, without revision or alteration by the Director.

thus become the most tangible and reliable record, not only of the investigations made, but always remain as authentic sources of information for all future work in the same direction.

Every specimen, therefore, which passes under investigation, becomes a part of the record which it is the function of the Museum to preserve.

In my own view of the matter there should always be a careful distinction made between collections which are the results of simple accumulation, and of those which are the results of investigation. The one are at all times procurable for money, but the other can only come from patient, continued labor guided by the scientific spirit. Such collections can never be duplicated for any price, and they become of constantly increasing value and importance. This distinction is not always nor indeed often made, and the catalogue showing the largest number of specimens in a museum collection is regarded as evidence of its superiority or of its activity in scientific work, while in fact, another collection of half the number of specimens may be of ten times the value to science and for scientific progress; and scientific progress means education of the higher order.

From the nature of the case there will always be a limit to scientific collections proper, while there need be none to elementary and heterogeneous accumulations, which may have neither scientific nor educational value; provided that the money resources and the capacity of an institution are sufficient to fulfill the demand for such purchases. Every museum, however, should be carried on with a purpose, and for the accomplishment of some specific object. The institutions for the diffusion of knowledge are many; those organized for the discovery of new truths or the creation of new knowledge are few.

The plan of the New York State Museum, as originally set forth in a recommendation of the standing committee on the State Museum and adopted by the Board of Regents in 1865, shows very clearly their views regarding such an organization, and it may not be inopportune to repeat it in this place.

On the 24th day of April, 1865, the Senate and Assembly adopted the following resolution:

"WHEREAS, The collections in geology, mineralogy and other departments of natural history, made by the geological survey of the State, were committed to the charge of the Regents of the University

by the act of the Legislature in 1845, and the reports published before and since that period as the results of the survey, have conferred great credit upon the State of New York, both at home and abroad, and the nomenclature proposed by her geologists has been adopted by other States, and in the geological survey of Canada, and is well known, appreciated and recognized by the scientific men of Europe, and

"Whereas, Great progress has been made since that period in geological investigations, both here and abroad, and it is due to science, as well as a suitable recognition of the great credit given to the State of New York, that her preëminence be sustained by keeping up the character and authenticity of her collections as a museum of practical and scientific geology; therefore be it

"*Resolved*, That the Regents of the University report to the Legislature, at its next session, what means may be necessary, together with a plan, for placing the State Cabinet of Natural History in the condition required by the present state of science, to maintain it in full efficiency as a museum of scientific and practical geology and comparative zoölogy; and whether the establishment of a system of free lectures in connection with the cabinet is desirable, and if so, on what general plan the same should be founded."

In reply to a circular letter, including a copy of the preceding resolution, addressed to the scientific men of New York and of the country generally, by the Secretary of the Board of Regents, the following among other suggestions were addressed to Dr. S. B. Woolworth, Secretary of the Board of Regents, under date of August 30, 1865, and subsequently adopted by the Board and recommended by them as the basis of a plan for reorganizing the State Cabinet of Natural History:

* * * * * * * * * * *

"Looking to the results of the geological survey of New York, the geological part of the Museum should be made dominant, as in this the State will derive more credit — assuming the geological formations of New York as a basis for arranging and parallelizing the collections from all the formations of other parts of the country, and at the same time giving to each one its appropriate place. This would also give to the Museum a distinctive character, and render it always a standard of reference and authority in geological science, while its development of the economic applications of the mineral products of the State will be at once and preëminently appreciated by the people.

"The State Cabinet of Natural History was originally organized as the result of the geological survey of the State, and the collections deposited therein were derived from the investigations in that survey. In the geological department, of this Museum, there was arranged for the first time in the history of American geology, a series of collections illustrating the order of sequence among the older formations. The plan of arrangement was adopted according to the best personal and collective knowledge of the four individuals to whom the geological survey had been assigned. It embraced:

"1. A geological collection, illustrating the sequence of the formations.

"2. A geographical collection, illustrating their distribution.

"3. A palæontological collection.

"4. An economical collection.

"Of these the first collection, embracing the series and showing the order of the formations, was fully arranged and completed. The second, or geographical collection, was essentially completed, but of course to be increased. The palæontological collection was scarcely begun, and the economical collection was not attempted, although a few specimens with that object in view had been accumulated.

"Beyond this, a collection in mineralogy had been arranged to illustrate the minerals of the State, and also one in zoölogy, with specimens in the several departments of that science; and also a botanical collection.

"Although much progress had been made in geological investigations since that period [1843], very little had been found to conflict with the arrangement which was then adopted; and in any reorganization of the Museum, the original plan and object should be returned to and kept in view.

"Among other points are to be considered the following:

"The historical value of the original collections can not be overestimated, as these furnish authentic means of study and comparison.

"The plan, therefore, should embrace a provision for the restoration of the old arrangement, the preservation and authenticity of these collections as they existed at the close of the work by the geological surveyors.

"Following this, the natural history of New York should be represented and illustrated by specimens in every department; deficiencies supplied, and provision made for special investigation among those classes or families of which we have but imperfect knowledge.

I. Requirements of a Museum.

"The present condition of science would require in any general museum a series of collections which may be named in the following order:

"1. Geological series proper, which should illustrate the nature and succession of all rocks with their accompanying characteristic fossils.

"2. A geographical series, exhibiting the character of the formation in each geological area, and for the State, each county or group of counties occupying the same geological formation.

"3. An economical collection in its fullest meaning, where all the products of the earth, applied to useful or ornamental purposes, shall be exhibited. This may be so extended as to show the results obtained in the several processes which the substances undergo in being prepared for their final uses.

"4. A collection in palæontology, embracing all the genera and species of fossils, together with their living analogues, arranged for critical palæontological and zoölogical studies. This, of course, should be first carried out for the State, and extended as rapidly as possible to other portions of the country, and finally for the entire globe.

"5. A collection in zoölogy proper, which after being completed for the State, should be extended over the United States, at least for certain classes and orders necessary in the study of comparative zoölogy. In this collection the external form alone should not be the final object, but *skulls, skeletons,* dissections and microscopic preparations should form a prominent part.

"6. A botanical collection, complete for the State, and extended beyond in those forms which present the nearest analogy or aid in illustrating the extinct vegetables of former periods. Specimens of vegetable structures, tissues, etc., should be accumulated from all parts of the country and the world."

II. Importance of Large Collections.

"A prominent object should be the acquisition of stores of duplicates in every department. This is necessary (1.) In order to ascertain the geographical range of species, their variations in different localities, or as caused by the different surrounding physical conditions; (2.) For means of making exchanges with cabinets and institutions, both in America and Europe (as is done by the Smithsonian Institution at Washington and by the Museum of Comparative Zoölogy at Cambridge), and also with individuals engaged in scientific investigations both here and abroad; (3.) For the great advantages which might be extended to the educational interests of the State, in supplying to colleges and academies authentically labeled specimens for illustrating their courses of instruction."

III. Cataloguing and Preparing Collections.

"(*a.*) An object of the first importance would be to obtain a catalogue of the materials in the cabinet as it at present exists. Until this be done, it is impossible to know in what direction efforts for its improvement are to be made.

"(*b.*) The next object to be obtained, and to be pursued simultaneously with the first, should be to fill up the deficiencies, more particularly in geology and palæontology, and whatever in other departments may contribute to their elucidation.

"(*c.*) The collections accumulated should as rapidly as possible be submitted to scientific scrutiny and investigation, description and cataloguing. The arrangement would be first in series, illustrating each species, together with sections, dissections and preparations, to be followed by the systematic arrangement of the whole.

"(*d.*) During the examination and preparation of collections, instruction and demonstration should be given for the benefit of such assistants and collectors as may be employed in the Museum.

IV. Publishing.

"The Museum should have the means of publication as the progress of work and investigation suggested will necessarily bring out results of great interest to the public. The publications might be similar to that now given by the Regents of the University, or that made by the Museum of Comparative Zoölogy at Cambridge. They would properly be:

"An annual report to the Legislature stating the general progress and result of the work carried on in the Museum.

"A bulletin to be issued as often as the progress of the work should require, accompanied by proper illustrations, and may be the repository of the permanent results of the operations of the Museum, both in scientific investigations and in their practical application to the pursuits of the community.

"Should the course of free lectures be adopted, these should, to some extent, be published, either in connection with the annual report or otherwise; and since they would have reference mainly to the practical application of science, they would find an appropriate channel of distribution through the Legislature.

V. Scientific Staff.

"The simplest form of organization at the outset would be as follows:

"A director, competent for the general charge of the Museum, and to carry on and direct investigations in the several departments.

"Two competent assistants.

"A taxidermist, competent to make the dissections and preparations, and to mount skeletons.

"A draughtsman, competent for any department, and who should be able to aid in the general work of the Museum, when his services are not otherwise required.

"An engraver.

"Collectors who may be temporarily or permanently attached to the Museum.

"In regard to the arrangement of materials and order of work, the Museum of the Geological Survey of Canada may furnish an admirable example. This museum in its arrangement was modeled after the original plan of that of New York, and has been carried out on the same plan. The organization of the Museum of Comparative Zoölogy at Cambridge (which has been commenced on a zoölogical basis), may be likewise taken as a guide in many things.

"After the organization shall have been fairly established, a few students could be admitted, who, having made their preliminary studies, might desire to take up the study of a special department, and, also, if competent and trustworthy, might for the time be intrusted with the collections belonging thereto; not simply for their personal advantage, but that they might place them and leave them in perfect order, with notes of their condition, deficiencies, etc. By this means much work might be accomplished without cost to the Museum. Many of the advanced students would doubtless be glad to avail themselves of the opportunity of making collections for the Museum by simply being allowed their traveling expenses, or with some small sum in addition. Thus large accessions could be made to the Museum and stores of duplicates acquired.

"As soon as the means of compensation can be obtained, a more complete organization is desirable. This should embrace, in addition to the offices enumerated, the following:

"A professor of chemistry, mineralogy and chemical lithology and geology. A professor of mines and mining engineering. A professor of zoölogy and general palæontology. A professor of botany and botanical palæontology.

"The two first named departments have especial reference to the practical wants of the community, and the two last named may be made equally available in their practical application.

"In order that the Museum should take rank with similar institutions in this country and in Europe, it is necessary that the services of men eminent in their several departments be secured.

"For this object the Museum must be able to offer facilities for investigation and publication, with materials at hand, and a scientific library, together with just and adequate compensation as an inducement for the best talent of the country to engage in its advancement.

"In order to secure unity of purpose and energy of action in the operations of the Museum, all its scientific purposes, relations and internal affairs should be left to the judgment of the director, while its general and pecuniary affairs should be administered by a committee, of which the director should be one."

VI. Expenditures.

"Taking the organization in the simplest form which would produce a direct result, there will be the following sources of expenditures:

"For salaries. For publication. For a library. For making collections. Incidentals.

"By a judicious distribution of the publications of the Museum they could be made to return to the library much valuable matter, thus aiding to increase the library without direct expenditure.

"The salary of the director should not be less than that of a professor in Columbia college. The salaries of professors and assistants would vary from $1,500 to $2,500 per annum.

"The Museum, on the initiation of the plan, might be conducted for a few years upon an annual expenditure of $10,000 or $12,000, while, as its operations become extended, and the plan fully developed, an annual expenditure of $25,000 or $30,000 will be required."

With a view of carrying out the plan of a museum organization, as thus recommended by the Regents, the present Director was appointed Curator of the State Cabinet in 1866, and a law expressing the purposes and objects of the New York State Museum of Natural History was passed in 1871.

It has been the constant effort of the Director, so far as he has had the ability and means to do so, to carry out the recommendations of these gentlemen. For many years previous to 1866, and while having no official connection with the institution, he had voluntarily contributed the results of his investigations to the Annual Museum Reports, in the hope of giving these documents a rank among periodical scientific publications. Since his appointment it has been his duty and pleasure to make the annual reports of the Museum a vehicle for the promulgation of new scientific truths, in accordance with the plan above cited. It has been only during the later years that the demand for the completion of the volumes on Palæontology has compelled him to forego the satisfaction of contributing some of the results of his investigations to the Annual Reports of the State Museum.

During the past year, while the current work of the Museum has been going on as usual, and the additions by collection, donation or purchase have been continued in various directions, we have been able to make a notable addition, not only to the collections of the Museum, but to our knowledge of the *vestigia* of some of the animals inhabiting the ocean of the Potsdam era.

Early in October, Prof. W. H. Benedict, Principal of the High School and Academy at Port Henry, N. Y., wrote me of his discovery of a slab of Potsdam sandstone in the sidewalk of a street of that village, which was marked by peculiar tracks or trails of some animal inhabiting the sea at the time of the original deposition of the sand. I at once wrote to him, in behalf of the State Museum, to secure this flag-stone, if possible, by guaranteeing its replacement by one equally as good for the purposes of a sidewalk. At the same time I urged him to find the quarry from which the slab had been derived, and to look for the layer marked by these tracks. In this, he was successful, and after a short time notified me of the fact. I then urged him to engage the manager of the quarry to work out this layer as far as practicable, and to mark the pieces as they came out, in order that they might be subsequently laid down, arranged in the same order and relation as in the original bed; thus giving us a representation of the conditions existing at the time of the deposition of the sand, and its slight covering of argillaceous matter which prevented the intermingling and coherence of the subsequently deposited sand with the previous deposit. In all this, Mr. Benedict has been very successful, and the slabs obtained will be sufficient to enable us to lay down a floor of more than twenty feet in length by eight feet in width.

Learning that the slab or flag-stone before mentioned was lying in front of the Sherman Free Library, I recommended Mr. Benedict to apply to the Trustees for the privilege of removing the flag and replacing it by another. Following my suggestion, he spoke to several of the Trustees about the matter, and he also suggested that I should write a letter to the board making application for the slab. As I was then preparing to go west for the purpose of collecting material for illustrating vol. VIII of the Palæontology of New York, I found no opportunity of writing the letter before leaving Albany on the fourteenth. At a later date, October

twenty-seventh, I did write such a letter, of which I append a copy, together with the reply to the same:

NEW ALBANY, IND., *October* 27, 1888.

To the Trustees of the Sherman Free Library, Port Henry, Essex county, N. Y.:

GENTLEMEN.— Professor Benedict has informed me that there is a flag of the Potsdam sandstone, in the sidewalk in front of the Free Library Building, which contains the tracks or trails of some marine animal, and which I would like to secure for the State Museum of Natural History in Albany. I have asked Prof. Benedict to negotiate with you for the exchange of that slab for another of equal size and quality, and have the new one put into the walk free of expense to the Library. I hope the Trustees may be willing to accept of this exchange and thus confer a benefit upon the State Museum of Natural History.

Very respectfully.

(Signed,) JAMES HALL,
Director of the State Museum.

PORT HENRY, N. Y., *November* 12, 1888.

Prof. JAMES HALL,
New York State Museum of Natural History, Albany, N. Y.:

DEAR SIR. — At a meeting of the Board of Trustees, on the ninth, it was moved and seconded and duly voted that the Board comply with your proposition as to removing stone, as stated in yours of October twenty-seventh and the Secretary was directed to notify you of their action, which I have the pleasure of doing.

Respectfully yours,

(Signed,) F. A. PRICE,
Secretary.

Through the liberality of Mr. Dudley Farlin, general freight agent of the Delaware and Hudson Canal Company, we were offered free transportation for the slabs to Albany; and we owe an acknowledgment to the local freight agent at Port Henry, who very kindly placed a car upon the switch at our disposal. The flag from the sidewalk and those directly quarried from the rock, were delivered in Albany on the twenty-fourth of November. The flag-stone from the sidewalk above referred to, which is about four feet square, is now exhibited in the area adjoining the

Museum Building on Lodge street. The other slabs and fragments which have all been preserved are temporarily placed within the area fence at the southeast corner of the State Hall.

I beg leave to recommend that some means be adopted for protecting these from the effects of the frost, and that every piece shall be preserved until they can all be laid out in the same relation to each other that they occupied in the original rock. By this means we shall be able to present a larger area of surface marked by these tracks than has ever been shown before from any source. This arrangement will also be important as enabling us to learn much more of the habits of the animal making these imprints, than can be learned from a single small slab, and more than is now known of the characters and habits of the animal. I would most earnestly recommend that this be done before any specimens are permitted to leave the Museum collections on any pretense whatever.

In this connection it may not be inappropriate to give a brief historical account of the discovery of tracks or foot-prints in the Potsdam sandstone of this country. The occurrence of tracks or trails upon the muddy or sandy beds of many of the geological formations is already well known. These were made by animals inhabiting the sea, or of others walking along the shallow water near its margin, thus impressing the yielding sand or mud which from receding tidal water or otherwise, may become hardened, and also perhaps more commonly covered with a thin film of clay, which prevents the intermingling of the succeeding deposit with that below, and after the induration of the whole the separation more readily occurs along this line of bedding.

Until about forty years ago I am not aware that any tracks or trails which were recognized as other than those of mollusks, had ever been found below the horizon of the Clinton group. The tracks in the New Red-sandstone of the Connecticut valley (originally referred to birds) are well known to every student of geology. The tracks and trails, probably of crustaceans, in the Clinton group have been known for nearly forty years, and some account of them was published about thirty-six years ago, though under an erroneous impression as to their nature. The first information we have of foot-prints in the Potsdam sandstone was derived from the Canada Geological survey, and the first published account of these impressions was given by W. E. Logan,

Esq., F. G. S., Director of the Geological survey of Canada, in the Quarterly Journal of the Geological Society, volume VII, 1852, page 247.* At page 250† of the same volume, Prof. Owen gives a detailed description of them.

At the time of the publication of this article, Prof. Owen regarded those impressions as probably due to some *Chelonian Reptile*, and that "the choice of reference lay between the *Batrachia* and *Chelonia*."

In the Quarterly Journal of the Geological Society, volume VIII, 1853,‡ there is a very interesting article on the Potsdam sandstone, and its Geological and Palæontological relations, under the following title: "*On the Foot-prints occurring in the Potsdam sandstone of Canada.* By W. E. Logan, Esq., F. G. S."

This article is very fully illustrated (1) by a colored geological map (plate VI) of a part of Canada "to illustrate Mr. W. E. Logan's paper on the Foot Tracks in the Potsdam Sandstone." (2) Plate VII. A PLAN of the FIELD with rock surfaces bearing Ripple-marks and Foot-tracks.

(3) Plate VIII. Enlarged portions of Rock-surfaces of the Field-plan shown on plate VI.

Following this paper is the one by Professor Owen § fully describing and illustrating these tracks and foot-prints from the Potsdam sandstone of Canada. In this paper there are described six species of *Protichnites*, viz.: 1. *Protichnites septem-notatus*; 2. *P. octonotatus*; 3. *P. latus*; 4. *P. multinotatus*; 5. *P. lineatus*; 6. *P. alternans.*

In this paper Professor Owen, after making a careful study of all the known forms of tracks in the geological formation, arrives at the "conviction that they were not made by any Chelonian Reptile nor by any vertebrated animal."

The impressions give evidence that the animal making them was furnished with more than two pairs of limbs, and they were referred to some large form of Crustacean, probably allied to the existing LIMULUS. At a latter date Prof. J. W. Dawson

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* "On the occurrence of a track and foot-prints of an Animal in the Potsdam sandstone of Lower Canada, by W. E. Logan, Esq., F. G. S."

† "Description of the impressions on the Potsdam sandstone discovered by Mr. Logan in Lower Canada, By Prof. Owen, F. R. S."

‡ "Quart. Journal of the Geol. Soc., vol. VIII, p. 199."

§ DESCRIPTION *of the* IMPRESSION *and* FOOT-TRACKS *of the* PROTICHNITES *from the* POTSDAM SANDSTONE *of* CANADA. By Professor Owen, F. R. S., F. G. S.

has confirmed this view of the origin of the foot-prints in an article published in vol. VII of the "Canadian Naturalist,"* page 71, giving the results of his observations upon the movement and resulting foot-marks of *Limulus polyphemus.*

At a later date, 1869, Prof. O. C. Marsh described a species of Protichnites — P. Logananus † from the Potsdam sandstone at Keeseville, N. Y. This species is much smaller than those from the Potsdam sandstone of Canada, and there is an entire absence of the median grove which is so characteristic of the Canadian forms described by Prof. Owen.

In June, 1860, Sir W. E. Logan read a paper before the Natural History Society of Montreal, upon the Track of an Animal lately found in the Potsdam formation. ‡

The tracks described in this paper are entirely distinct and very different in their characters from any of those before discovered, and are identical, at least in generic characters, with those recently discovered at Port Henry, in Essex County, New York. I can scarcely render a better service, to those who will care to study these impressions in this new locality, than to transcribe the paper of Sir W. E. Logan entire, and which I have appended to this communication; but without expression of opinion as to their origin.

Sir W. E. Logan has referred these tracks to a crustacean animal, though they are very distinct in their characters from those described as of crustacean origin by Prof. Owen, and from their peculiar character have been designated as Climactichnites. Since we know of no larger fossil forms in the Potsdam sandstone than Trilobites and a single genus related to Limulus, we are naturally led to refer all tracks or foot-prints to crustacean origin for the want of knowledge of any other fossil organisms in the rock capable of making such impressions. The markings under consideration do not appear to have been made by an animal provided with free movable limbs, or otherwise, with very short limbs, without the acute appendages belonging to Limulus.

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* Article XXVI. On the foot-prints of Limulus, as compared with the Protichnites of the Potsdam sandstone. By J. W. Dawson, LL. D., F. R. S., etc,

† Article V. Description of a new species of Protichnites from the Potsdam sandstone of New York. By O. C. Marsh, Prof. of Palæontology in Yale College (with a plate).

‡ Article XXXIX. On the Track of an Animal lately found in the Potsdam formation By Sir W. E. Logan, F. R. S. (Read before the Natural History Society of Montreal June, 1860.)

On the Track of an Animal Lately Found in the Potsdam Formation.

By Sir W. E. Logan, F. R. S.

[Read before the Natural History Society of Montreal, June, 1860.]

"The Potsdam sandstone is recognized in Canada and New York as the base of the Lower Silurian series. As far as we are certain of the formation in the province it rests unconformably upon the Laurentian series; but on the north shore of Lake Huron, the Huronian series supports unconformably a sandstone which has been supposed to be Potsdam; as no fossils, however, have been met with in it there, its equivalence is somewhat doubtful, particularly as the superior fossiliferous rock into which it passes, appears to be the Bird's-eye and Black River group.

"Mr. Barrande in a paper communicated to the Geological Society of France about a year ago, compares the Potsdam formation with the Primordial Zone, and appears disposed to unite it with the strata marked by *Paradoxides* near Boston in Massachusetts, and Placentia Bay in Newfoundland, the first locality yielding *Paradoxides Harlani* which he identifies with his *P. spinosus* and the latter Mr. Salter's *P. Bennetii*, and probably other allied genera and species. But while no well ascertained Primordial species have been met with in the Potsdam of Canada and New York, the formation appears in Canada to be rather allied to the strata above than those below it.*

"In the Potsdam of Canada and New York, independent of fucoids, the number of species of which the forms have been either wholly or partially preserved is only three. Two of them are *Lingulæ* named by Hall *L. prima* and *L. antiqua;* and while these so far resemble one another that they might by some palæontologists be considered variety of one species, we in Canada have a *Lingula* (*L. Belli* of Billings), in the Chazy, which might almost be considered another variety of the species, the peculiarity of them all being the length and sharpness of the beak. In Canada there is also found in the Potsdam the impression of a spire of a large flat Pleurotomaria, which so strongly resembles the spire of *P. Laurentiana* (Billings) of the Calciferous, that they can scarcely be distinguished. In addition to these upward affinities in the only preserved forms, there are beds of passage between the Potsdam and Calciferous formations, in which the strongly marked distinctive lithological characters of the two are well preserved, and at St. Timothy on the Beauharnois Canal those beds of

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* Since this paper was read, it has been ascertained by Mr. Billings, that the trilobites found in the Potsdam at Keeseville, New York, and presented by Mr. Dana at the meeting of the American Association at Montreal, in 1857, belong to *Conocephalus*, one of the genera characterizing the Primordial Zone in Bohemia.

the inter-stratification which are allied to the lower rock are occasionally marked by *Scolithus linearis* (Hall), supposed to be ancient worm-holes, by which the Potsdam is characterized in many parts.

"Immediately beneath these beds of passage are the celebrated foot-prints of Beauharnois, to which Professor Owen has given the name of Protichnites. Since these were described by Owen, nothing has been discovered to throw further light upon the forms of the animals which made these impressions; but in thinning a large specimen with some of the tracks on it, for the purpose of placing it in the museum of the Geological Survey, it was ascertained that the surface on which the traces were impressed must have been subject to the ebb and flow of tide. The surface on which the tracks are impressed and the one immediately beneath, show ripple marks; the next in succession, which is about an eighth of an inch below, shows wind marks in a number of sharp and straight parallel ridges from two to four inches long and an eighth or a quarter of an inch wide. These characterize a considerable surface, and are precisely similar to the marks so familiar to every person who has examined blow sand. The surface must thus have been alternately wet and dry, and the organic remains of the formation being marine, we have thus pretty clear evidence of a tide.

"Proverbially unstable as water is, the mean level of the sea, that is, the point which is half-way between high and low water, is supposed to be the least changeable level on the face of the globe, and taking it to be now pretty much as it was during the Lower Silurian period, we establish the means of knowing approximately how much the position where the tracks are found, is higher than it was when these were impressed, the limit of error being the number of feet which would represent the difference between the ebb and flow of the sea in the locality, or perhaps not more than fifty feet. We have thus a bench-mark to test the rise, not only of these strata at Beauharnois, but of their equivalents, wherever else they may be met with.

"Finding that this ancient sand bank was exposed at the ebb of tide we naturally look out for some coast to which it was related. The Potsdam sandstone terminates some twenty miles to the north at a very low angle against the foot of the Laurentian hills, which rapidly rise up 500 or 600 feet above the Silurian plain. There is little doubt that we have in the flank of those hills the ancient limit of the Lower Silurian sea, the shore of which is thus traceable from Labrador by the northwest, to the Arctic Ocean, a distance of 3,000 miles. But, though we have thus evidence of a Lower Silurian dry land and can scarcely suppose that it was wholly destitute of vegetation, we have

not yet discovered any certain drifted vestige of its plants along many hundred miles of its coast.

"The crustacean which impressed the tracks at Beauharnois must have been a littoral animal, tracks of which have now been found in several places nearer than Beauharnois to the marginal limit of the sea to which it belonged. These localities are St. Ann, Vaudreuil, Pres-qu'ile, Lachute and St. Elizabeth, and they were last year observed in the neighborhood of Perth. In the last locality they are associated with a new and remarkable description of track for the discovery of which we are indebted to my friend Dr. James Wilson of Perth, who sent me specimens of it in the month of November last.

"The largest of the specimens was between two and three feet long by a foot wide, and the track upon it so singular that I became desirous of obtaining a greater extent of the trail. For this purpose, in the beginning of December, I sent Mr. Richardson to Perth, where he was guided to the quarry by Dr. Wilson, and shown the bed in which the tracks occur. The quarry, of which the strata are nearly horizontal, is about a mile from the town, and with the aid of Mr. Glyn, the proprietor, Mr. Richardson obtained in fragments, a surface which measures about seventy-six square feet. To obtain this required a good deal of patience, for there was half a foot of snow on the ground, and from under this it was necessary to remove between two and three feet of rock in order to reach the bed. The rock is a fine-grained white Sandstone similar to that in which the PROTICHNITES occurs at Beauharnois, and of that pure silicious character which is so well known to belong to the Potsdam formation wherever it is met with. The tracks are impressed on a bed which varies in thickness in different parts from one-eighth of an inch to three inches. When the upper bed was removed, large portions of the track-bearing bed came away with it, and it was necessary to separate the layers. This was done by heating the surface with burning wood placed upon it, and then suddenly cooling it by the application of snow. This, of course, cracked and destroyed the thin bed with the impressed tracks, but it left the mold of them on the under side of the upper bed, and by plaster casts from this we have obtained the true form of the original tracks.

"These tracks consist of a number of parallel ridges and furrows something like ripple marks, which are arranged between two narrow continuous parallel ridges, giving to the whole impression a form very much like that of a ladder, and as the whole form is usually gently sinuous it looks like a ladder of rope. The surface obtained shows six different trails (Fig. 1), the longest of which is about thirteen feet,

but they are all of the same breadth, and they may all have been impressed by one and the same animal. The breadth of the trails is about six inches and three-quarters to the outer side of them."

"The transverse ridges and furrows are sometimes straight (Fig. 2), and sometimes curved (Figs. 3-4-5). When straight and regular they measure about an inch and three-quarters from the middle of one furrow to that of the next. The height of the ridge is usually from one and a half to two lines, and from the highest part the distance to the middle of the furrows is about an inch and a quarter on one side and half an inch on the other, thus giving to the ridge a sharper slope on the shorter side. The tops of the ridges and the bottoms of the furrows are somewhat rounded.

"Though the transverse ridges are occasionally straight (Fig. 2) they are in general either slightly or considerably curved (Figs. 3–4–5) and when so, the chord of the curve is seldom quite at right angles to the direction of the parallel side ridges, one end of the chord in the greatest obliquity observed, being as much as two inches and a half in advance of the other (Fig. 3).

"The height of the curve above the chord is sometimes as much as an inch and three-quarters. It is often somewhat pointed, and the highest part is not always in the middle between the parallel side ridges (Fig. 4). The concave side of the curve is always on the steeper side of the transverse ridges.

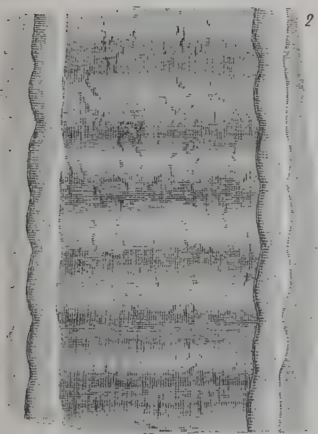
"There runs along the track a ridge intermediate between the two parallel side ridges (Fig. 3–4–5), and though it is not so conspicuous as these, it is seldom altogether wanting, but appears to be most obscure when the transverse ridges, or rounds of the ladder, are straight. This intermediate ridge does not keep parallel with the side ridges, but occasionally runs in sinuous sweeps from within an inch and a half of one side (Fig. 5) to the same distance from the other; sometimes however, it runs nearly parallel with the sides for a considerable distance, either in the middle or somewhat on either side of it. In one of the tracks in the course of the intermediate ridge a sudden dislocation of an inch and a quarter (Fig. 3 towards the top) on the opposite sides of one of the transverse ridges. The course of the intermediate ridge appears in general to coincide with the successive most salient parts of the transverse ridges when these are curved, but this is not always the case (Fig. 4). The intermediate ridge appears most conspicuous where it crosses the tranverse furrows, yet its crest or line of summit seems to undulate with the ridges and furrows, though not to so great a degree.

"The inner flanks of the side ridges appear to be continuously even surfaces, making an angle of 155° with the plane of the intermediate spaces, and against these sloping flanks the surface of the transverse undulations forms a decided, though very obtuse set of angles, just like waves rolling along an inclined plane in the direction of its strike. The side ridges are rounded at the top, and while their exterior flanks are more precipitous than the interior ones, they swell out opposite to each transverse furrow, thus giving to the side ridges a beaded or knotted aspect, each bead of the series standing opposite a furrow. The highest part of these lumps is about three lines above the bottom of the furrows, and about a line and a half above the surface on which the track is impressed.

"My naturalist friends to whom I have exhibited the specimens, appear disposed to consider the tracks those of some species of gigantic mollusk, and I am given to understand there is now living some small mollusk, whose track presents a series of tranverse ridges and furrows, without, however, the longitudinal ones. From the resemblance of the track to a ladder, the name proposed for it is *Climactichnites Wilsoni*, the specific designation being given in compliment to its discoverer, Dr. Wilson."

CRUSTACEAN TRACKS [?]

2



1/5 Natural Size.

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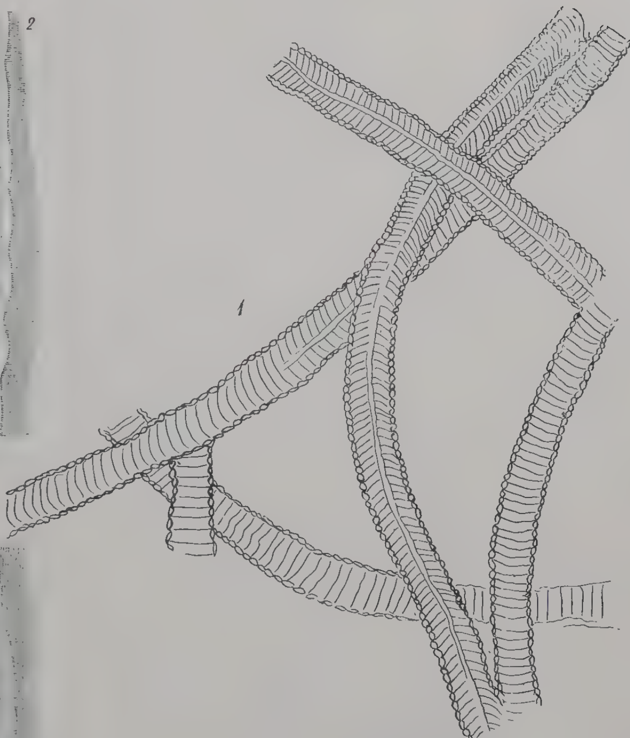

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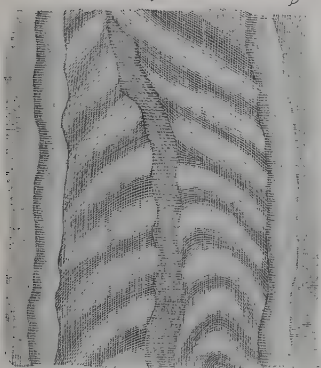

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1/5 Natural Size

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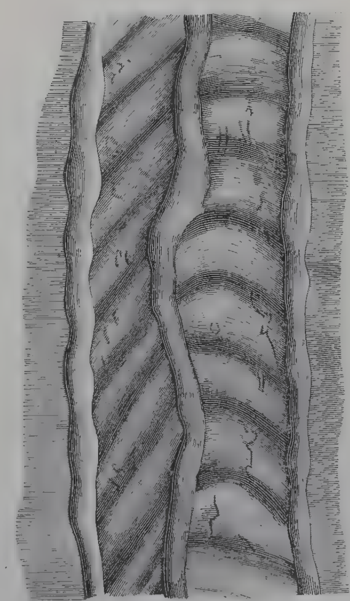

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The preparation of the Museum Bulletins upon the Palæozoic Lamellibranchiata and upon the fossil Dictyospongidæ, has scarcely progressed at all during the past year, mainly for the want of authority to go on with the lithography, which should be done in advance of the letter-press part of the work. Since the acceptance of the Bulletin on the Lamellibranchiata, I have had made a considerable number of original drawings of characteristic generic forms, which are now ready for use by the lithographer whenever the work shall be ordered. Other drawings would have been made, but we have no available means for such work.

The want of a draughtsman for general or special work is a great cause of retardation in almost every direction at the present time, and will ultimately prove a serious obstacle to progress. We are now restricted, by law, to drawings upon Brachiopoda, and have not the privilege of having illustrations made of any other class of objects.

I have already reported the completion of the drawings for the Dictyospongidæ, as far as required, to illustrate the material in my hands in 1884. Since that time considerable new material has been added to that which we previously possessed, and a considerable number of other drawings will be required to complete the work. It is also very important that all the known localities within the State be revisited and further collections be made. I can not but regard it as a misfortune to the Museum that the completion of this work has been so long delayed.

Since the work of the Palæontology has been restricted to a single class of fossils (the Brachiopoda) and from the fact that on the return to this work last spring (May, 1888), after the completion of the Crustacea, vol. VII, the collections were found to be very deficient in material for the preparation of the plates; the lithographer has, therefore, sometimes been left without work. The same condition has often happened in the past three years. Could the lithographer have taken up the work on the Dictyospongidæ during these intervals of forced idleness, we would by this time have had a large portion of these plates lithographed.

Although the preliminary descriptions have been published in the Museum report of 1884, that work can not be regarded as entirely complete, or satisfactory as a contribution to science. Since we have so much means at our disposal, it seems unfortunate to postpone the completion of a scientific investigation, which

would be eminently creditable to the State Museum could it be placed before the public.

In order to accomplish this work within a reasonable period, the lithographing of the plates should be commenced at the earliest opportunity, and the services of an intelligent collector be enlisted for the coming season's field work.

In my report of last year, I have referred to this matter of these proposed Bulletins, and have more especially recommended the completion of the one upon the Lamellibranchiata as a work which would be of immediate service to students and teachers in science. In order to facilitate an appreciation of this work, I communicated a list of generic names of those already illustrated, and of those required to complete the Bulletin. I can scarcely make a more earnest recommendation than I have recorded in my report of last year.

I am, very respectfully, your obedient servant,

JAMES HALL,
Director.

REPORT OF THE ASSISTANT IN CHARGE.

James Hall, LL. D., *Director of the New York State Museum of Natural History, Albany, N. Y.:*

Sir.— I transmit herewith my report as Assistant-in-charge of the New York State Museum of Natural History, for the year ending December 1, 1888.

Respectfully,

JOHN C. SMOCK.

Albany, N. Y., *December* 1, 1888.

Current Work.

My time has been given to the general care of the collections, the ordinary office work, with its correspondence and answers to inquiries relative to the State and its natural products; to the selection and purchase of collections for the increase of the Museum, to the examination and disposition of donations, to the preparation of mineral collections for distribution to schools in the State, to the field work in the line of economic geology, and to the general direction and supervision of the work of the assistants.

The increasing number of calls and requests by letter for information upon the localities and extent of natural products of economical importance occurring within the limits of the State, demands more time and personal attention each succeeding year. Inquiries about all of our mineral staples come to the office. So far as possible, full and definite answers are given to all such requests. The dissemination of information of this kind is regarded as one of the most important parts of the office work, and is a practical return of the Museum to the people of the State. The exhibition of specimens of our natural products in well classified and arranged collections, illustrating their variety and occurrence, would assist greatly in this work of giving information upon these mineral staples.

My field work, this year, has been in the iron-ore districts of the State. All of them have been visited, and nearly all of the

mines in them. Notes for a preliminary report thereon have been made and valuable statistics gathered. A collection of nearly 500 specimens of ores and associated rocks has been received through the assistance of mine-owners, managers and superintendents.

Mr. Chas. E. Beecher, Assistant Palæontologist, has given some time each month to the Museum, and rendered most efficient aid in timely suggestions and advice in questions relating to the selection of material to be purchased, modes of arrangement, and the general management of the Museum. Through his efforts valuable exchanges have been effected with the Yale College Museum, and choice and much-needed collections of fossils purchased in Europe.

Mr. William B. Marshall, Assistant in Zoölogy, has had the special care of the collections in that department. The mammals have been rearranged by him in the newly-fitted cases; the birds have been reidentified, following Ridgway's system of nomenclature; the Beecher collection of Unios has been mounted, and nearly all of the specimens in the Zoölogical department have had newly-written labels put on them. In the Mineralogical department he has written new labels throughout. He has kept the record of accessions to the Museum, and attended to the exchanges of the library, and a card catalogue of the latter has been made. The general clerical work of the Museum has been done by him, including part of the ordinary correspondence. In the work of preparing this report he has rendered much assistance.

Martin Sheehy has been employed in making transparent sections for the exhibition of the structure of crystalline rocks, building stones and fossil Brachiopoda for microscopic study. Because of the many necessary calls upon him to assist in packing and unpacking collections, and in the general work of caring for the collections in Geological Hall, he has not been able to give all of his time to rock-cutting. The equipment of the laboratory has been improved by the purchase of diamond saws, which have greatly increased the efficiency of the machinery in use. A further improvement in the construction of the lathe is desired in order to do the work of cutting more quickly and accurately and to thus avoid the loss of time now consumed in grinding down the sections by hand to the requisite thinness. The work of the year has been to prepare 125 microscopical sec-

tions of crystalline rocks; eighty-eight transparent sections of building stones of New York; 200 microscopical sections of fossil Brachiopods, for the use of the Director of the Museum in his work on the Palæontology of the State.

Arrangement and Addition.

The changes in the exhibition-rooms of the Museum have been mainly in the rearrangement of the collections and in relabeling the specimens. No additional cases have been constructed, but several alterations have been made, which give more space and display to better advantage the collections as rearranged.

On the principal floor and at the side of the entrance hall, the general collection of minerals has been arranged, mounted and labeled. The rooms are fairly well-lighted by windows on the front and at the back. The cases built against the walls afford space for the exhibition of large specimens, and three table cases in the body of the room, admit the selected specimens, which may be viewed with more ease and more scrutiny of detail. The case of precious stones also stands in the back-room, in front of the window, where it receives a strong light. In the work of arranging and mounting the collections, Mr. Frank L. Nason, of the Troy Polytechnic Institute (now of the Geological Survey of New Jersey), was employed during the months of January and February. The care shown in the selection of the specimens, the neatness and simplicity in the arrangement on the shelves and the taste in the mounting, are evidences of his skill and painstaking labor. In making this new mineralogical collection, the minerals which were purchased of George F. Kunz, of Hoboken, N. J., in September, 1886, constitute the greater part. The old general collection was broken up, and the choice specimens incorporated with the former, as also the Emmons' collection of crystallized minerals of northern New York. What were known as the Gebhard, Pickett, Brazilian and Emmons collections, have thus disappeared as such; the specimens selected retaining, however, on their labels their respective sources, for identification. One lot of calcites from Rossie, St. Lawrence county, in the Emmons collection, is placed intact, in one of the cases of the new room. The arrangement in the wall cases in the rooms is according to the plan of Dana's System of Mineralogy, beginning with the native elements in the first case (No. 1.), at the left hand,

on entering the room, and so continuing from left to right in consecutive order to and including case No. 26. There are on exhibition in the wall cases upwards of 2,400 specimens. They are mounted on wooden tablets with the front edge beveled for the attachment of the label. The labels have the name of the mineral species and variety printed in two lines at the top, and below these are written the locality, and the name of the donor or collection from which the specimens is taken. The first table case, near the entrance door, is occupied by pseudomorphs and an incomplete collection of minerals illustrative of their physical properties; and, for the present, by four large Toluca meteorites. The second table case, in the front room, has in it the better examples of crystallized minerals belonging to the Museum, and also some of the more beautiful specimens without reference to crystallization. There are in this case about 1,100 specimens.

In the long table case in the back room the showy minerals from Bergen Hill, N. J., are exhibited, numbering about 300 specimens. They represent nearly all the species ever found in that district, and the collection is probably the best of its kind in the country. It possesses especial value as representing a group of minerals occurring in a particular district. The pectolites, natrolites and apophyllites are remarkably fine.

The case of precious stones, also in this room, has in it fine specimens, mostly of the varieties which are employed for gems. A catalogue of the case was given in the last annual report. During the year the following cut stones have been added, viz.: Amethyst from South Carolina, Jadite from China, Green Garnet from Siberia.

The additions to the mineralogical collection are not numerous, but they are of particular interest. Especially deserving of notice here is the collection of New York island minerals, purchased of Geo. F. Kunz, of Hoboken, N. J. It contains all the characteristic, as well as common, mineral species found occurring naturally on the island, and, in view of the early disappearance of the outcropping ledges and the covering of mineral localities by the growing city, its value must increase. Three masses of meteoric iron from Toluca Valley, Mexico, weighing eighteen, fifteen and three pounds, respectively, also deserve mention, as they serve as representatives of this class of meteorites. By the side of them lies a beautiful model of the Cabin Creek, Arkansas, meteoric

iron, prepared by J. C. Hendley, of the U. S. Geological Survey and presented to the Museum by Mr. Kunz. Another lot of minerals of value as representing fully a locality, is a series of fifty-eight specimens from Pelham, Massachusetts, presented by Prof. John M. Clarke of Albany. A large block of remarkably well crystalized magnetite from the Palmer Hill Iron Mine, Clinton county, the gift of H. D. Graves, Esq., of Ausable Forks, also, is noteworthy. Another collection, but not yet placed on exhibition, is that purchased of Mr. Kunz, and from Westchester county. It contains some fine rutile crystals and good specimens of tremolite, from Sing Sing. Still another noteworthy lot of minerals are the magnificent groups of green fluorite, recently discovered in St. Lawrence county. They surpass all the specimens ever found in that county.

The collection of building stones occupies the entrance hall and all the available space therein is filled, so that the additional specimens have to be either crowded upon each other on the shelves or put away in the store-rooms in basement. Among the additions of the year are: A slab of red slate, six feet, three inches by nineteen inches, from the Hatch Hill quarry, East Whitehall, Washington county. It is the gift of R. A. Hall, and it is a showy specimen of the deep-red, fine-grained slate, so characteristic of the region, and found only in New York State. The other additions to this collection are given in the list of accessions.

The second-story room of the Museum remains unchanged in its general arrangement of cases. In it the collections of the State Geological Survey are placed in the order of their geological horizons, and nearly the whole room is devoted to the rocks and fossils of the New York series. Many of the more valuable palæontological specimens have been removed to the State Hall for safety against fire, and the gaps thus made have lessened the value of the collection as illustrative of the characteristic forms of life of the successive periods, and also detracted from its beauty. A rearrangement of the material in the palæontological cases is desirable.

Among the more important additions this year in this department are: A large slab of slate from Middle Granville, Washington county, which shows several markings of the fossil organism,

described in the Thirty-ninth Annual Report of the State Museum as Dactyloidites bulbosus.*

The stone is four feet square. It was secured for the Museum by H. A. Ingalslee, Principal of the Middle Granville Academy. A slab of Medina sandstone, covered with Lingula cuneata, quarried for flagging at Medina, Orleans county. It was presented by Patrick Horan of Medina. A third specimen worthy of mention is a block of pyrites from Davis, Mass., the gift of Mr. H. J. Davis of that place.

The changes on the third floor, which were made last year, left vacant the alcove cases at the front. They have been filled with a part of the palæontological accessions of the year. Among them the following may be mentioned as important additions: A collection of twenty-four specimens of Jurassic fossils from Solenhofen, Bavaria; 109 specimens of Devonian, Cretaceous and Jurassic fossils from European localities; twenty-six specimens from the cretaceous formations of the United States — these are from Yale College Museum, and were obtained by Mr. Beecher. A collection of 109 specimens of fossils from the Spiriferen Sandstein of the Hartz Mountains, Germany, from the Geological Museum of the University of Göttingen, obtained by exchange through Prof. A. von Koenen. Their identification by such an authority gives them special value for comparative study. Cretaceous plants from Ellsworth county, Dakota, purchased of Prof. Snow, of the University of Kansas. Two sections (polished) of the large and beautiful Ammonites stellaris, from England, purchased from Ward & Howell, of Rochester. Other additions in this room are a finely preserved specimen of the Icthyosaurus communis, from the Liassic beds at Lyme Regis, England. As the representative of the great saurians, it is unique and attracts much attention. It is exhibited in a table case, at the east end of the room.

The ethnological and antiquarian collection of the museum, formerly in cases on the top floor, has been brought down and arranged temporarily in a wall-case at the front of the room. The pressing need of these cases for the increasing collections of Mesozoic and Cenozoic fossils will necessitate its early removal to other quarters.

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* Thirty-ninth Ann. Report N. Y. State Museum, page 160. with plate 11.

The vacant floor space in this room will have to be reserved for new table cases, which are needed for the proper exhibition of the Jurassic, Cretaceous and Tertiary fossils.

Zoölogical Department.

During the year a great portion of the work in this department has been devoted to a rearrangement of the specimens already on exhibition. The collection of antiquities, which occupied the east-north wall case on the upper floor, has been removed to a case on the floor below, and the space thus gained has been filled with stuffed specimens of fishes, reptiles and amphibians. The collection of bones, skeletons and skulls has been taken out of the south-east wall case and disposed as follows: The jaw of the sperm whale over the doorway entering the building from State street; the smaller skeletons and the skulls have been placed in new, upright cases in the center of the room, and the stuffed specimens of horse-mackerel, the two sharks, the saw-fish, the boa constrictor and the shell of the large Galapagos turtle have been placed on top of the cases containing the birds.

The skeletons of the buffalo, moose and elk have been taken from the middle east wall case and placed beside the stuffed specimens of the same animals respectively, in the west wall case. The space thus gained is devoted to the two hooded-seals and the harbor-seal purchased recently, and to the group of beavers.

The smaller animals have been removed from the west wall case and deposited either in the new upright cases in the body of the room or in the southeast wall case. As now arranged the entire west case is devoted to ungulates of the ruminant order and the southeast case is devoted to carnivorous animals—cats, foxes, wolves, bear and wolverine.

In the northeast wall case the specimen of giraffe, which was elevated upon irons about three feet from the floor, and the skeleton of rhinoceros which was mounted on irons above the stuffed rhinoceros, have been lowered until the pedestals rest upon the floor. In addition to these three specimens, this case contains an adult male and a young walrus.

At the time of making the last report the Unios of the Beecher Collection were in course of preparation for exhibition. In January they were placed on exhibition, a little more than half of the west table case being used for that purpose. The Smith-

sonian Collection of shells which formerly occupied this case has been placed in the drawers underneath.

Early in the year the greater part of the collection of turtles was loaned to Dr. G. Baur, of Yale College, who has been making a special study of those animals. He identified the specimens and affixed to each its correct name and its synonyms. Since the return of the turtles they have been mounted upon fine, polished walnut pedestals prepared by the La Rose Mfg. Co., and upon each specimen a label has been placed, giving the English and Latin names, and all the data that could be secured respecting place of capture, donor, etc.

During the year the collection of birds, which had been put in good repair by Prof. H. A. Ward, has been placed in the new cases built to receive them, and replacing the two cumbersome cases in which this collection was formerly deposited. This arrangement of the specimens, although it is but temporary is a great improvement upon the old arrangement, devised by the former taxidermist. With the old cases, in order to come at the birds, it was necessary to take down one or more of the sashes which were about ten feet in length and very unwieldly, while the shelves, which were arranged in a pyramid of steps and immovable, gave no opportunity to adjust the height of the shelves to the size of the birds. The locks and the adjustable shelves in the new cases obviate these two objections, beside affording room for about double the number of specimens.

The specimens of birds in the Museum have been reidentified and the most recent nomenclature adopted. At present the old labels are in service but it is proposed to replace them with new ones in the near future. In printing the labels, care will be taken to give the common or English name rather more prominence than the classical or Latin name. This method has been applied to the specimens of mammals which have been relabeled and it appears to meet the approval of the public, although strictly scientific men think it unnecessary.

The collection of birds, as it now stands, is in no wise representative of the avian fauna of the State. Not more than one-half the number of birds inhabiting the State is represented by specimens and in very many cases only one sex of a species is present. With some birds one sex can be made to answer, as there is but little difference between the two sexes. In the great majority of instances,

however, both sexes should be exhibited, and in addition, there should be specimens illustrating the seasonal changes in plumage whenever such changes are at all noticeable. It is hoped that the Museum authorities will authorize the expenditure of some part of the present annual appropriation for the purpose of supplying the immediate wants of the ornithological collection. It is believed that about $900 to $1,200 will be sufficient to secure a representative of every species inhabiting the State and not now represented in the collection. Other details of improvement could be worked out at leisure.

The additions to the zoölogical collections for the year (Appendix) include several specimens worthy of particular notice, viz.: A female moose, male reindeer, male and female hooded-seal, male harbor-seal, wolverine and American sable or marten. All of these animals were prepared by Prof. H. A. Ward, and represent examples of the highest skill in taxidermy. The skins are in excellent condition and this feature, in combination with the good workmanship which has been bestowed upon them, and the fine pedestals upon which they are mounted make them works of real art; while the great interest which the people manifest in the larger mammalia gives them an additional value from an educational standpoint. Each of these animals (with the probable exception of the reindeer) is a member of the existing or historic fauna of the State, although the harbor-seal is the only one of the number captured within State limits. The Museum had a skeleton and a stuffed specimen of the male moose, both taken from animals captured within the State many years ago, and it seemed well to secure a specimen of the female, and thus complete the suite illustrating that animal. There is no trustworthy evidence to show that the reindeer ever inhabited New York, but as it forms a part of the near-by extra-limital fauna, and is often mentioned in newspapers and in the writings of arctic explorers it was thought proper that a specimen should be placed in the collection. The other animals mentioned above, as well as some others which were purchased, form part of the living fauna of the State, and the reason for purchasing them is obvious.

The work of the Zoölogical Department for next year will be mainly as follows:

The Anodons and the fresh-water and terrestrial univalves of the Beecher collection, will be prepared for exhibition; the

birds will be permanently arranged and labeled, and a catalogue prepared; the collection of echinoderms will be arranged; the Gould Collection of shells will be worked over with a view to modernizing the nomenclature. Five of Blaschka's glass models have been purchased. As these models are excellent representations of animals, which, at best, can only be preserved in alcohol, and in most cases can not be preserved at all, they constitute valuable additions to the Museum. These models are exquisite in workmanship, and aim to give every detail of structure and coloration with the same delicacy as is found in the living animal. It is proposed, if the trustees consent, to add more of them to the collections.

LIBRARY.

The library has been removed from room No. 30 of State Hall, and part of it deposited in the northeast room and the remainder placed in the basement room of Geological Hall. To accommodate the latter, cases were built against the west side of the room, affording space for about 500 volumes. This arrangement is not altogether desirable, and is a temporary relief only. In the same room a small hood has been constructed for carrying off the gases in any chemical tests which are occasionally necessary. The room serves the double uses of a working laboratory and library.

Annual Reports 36 to 39 and Bulletins Nos. 2 and 3 have been sent to many of the more prominent museums and scientific societies. Each budget of reports included a circular requesting the various recipients to enter upon a regular exchange of publications. A comparison of the accessions to the library for this year (Appendix) and the preceding, will show that this circular met with some measure of success.

BULLETINS.

In 1887 it was resolved to publish part of the scientific work of the Museum in the form of bulletins, which should appear from time to time, as material accumulated. Thus far, Bulletins Nos. 2, 3, 4 (consisting of new material), and 5 and 6 (consisting of reprints of Dr. Lintner's papers in the fortieth report) have been published. Bulletin No. 2, by Prof. Peck, containing sixty-six pages and two plates, is a further installment of his excellent work on the Fungi of New York.

A report on the quarries of building stone in the State was prepared in the winter of 1887–88, and published as Bulletin

No. 3, in March. It contains a general description of the stone, which is quarried for purposes of construction, following the geographical distribution and the geological positions of the formations and outcrosses, and an account, in detail, of the several quarry districts and quarries. The location, extent, ownership, and statistics of the quarries are given, and the markets, prices, uses and references to examples in construction of the stone, so far as they could be ascertained. The wide-spread and steady demand for this Bulletin, notwithstanding its distribution to all quarry owners and others interested in constructive materials in the State, is a proof of the service it is rendering our architects, builders, quarrymen and people generally. And it shows the need of similar publications upon all the natural products of the State, which are of economic importance. The dissemination of information upon their occurrence, nature and uses, is one of the most important aims of a State Museum. Bulletin No. 3 contains VI and 152 pp.

The scheme for the publication of bulletins on economic subjects as announced in the preface of No. 3, proposes a second Bulletin upon the building stone of the State. It is to be devoted to a comparative study and to the extent and value of the use of stone in construction in our cities. A large part of the data relating to stone construction has been obtained. As soon as the necessary analyses and tests can be made the report thereon will be prepared for publication.

A reconnoissance of the iron ore districts has been made during the past season and notes of the mines and their working, with their statistics, their output and markets have been collected for a bulletin or preliminary report on the iron ores of the State. It can be made ready for the printer early in 1889. According to the present plan it will be followed by a second bulletin giving full descriptions of the mines and of the occurrence of iron ore in the State. The labor of collecting the material for this latter bulletin will probable cover the whole field season of the coming year.

The rearrangement of the collection of minerals suggested the publication of some notes on its more important features. Mr. Frank L. Nason, instructor in the Troy Polytechnic Institute, was employed to prepare an account of three of the more important suites of minerals. His notes thereon, illustrated by one plate of figures, have been printed as Bulletin No. 4. It describes the occur-

rence of the newly discovered brown tourmalines in Newcomb, Essex County; the pyroxenes and associated minerals of Chilson Hill, Ticonderoga; and the calcites of the Emmons collection. This Bulletin is an 8vo. of nineteen pages, and one plate. Collections of fossils have been sent to the following schools:

Waverly Union School, Waverly, N. Y.; P. M. Hull, Principal.

Academic High School, Auburn, N. Y.; E. L. Elliott, Principal.

Stillwater Academy, Stillwater, N. Y.; Alex Falconer, Principal.

Greene Union School, Green, N.Y.; Welland Hendrick, Principal.

Elmira Free Academy, Elmira, N. Y.; H. M. Lovell, Principal.

De Ruyter Union School, De Ruyter, N. Y.; Irving P. Bishop, Principal.

St. John's Catholic Academy, Syracuse, N. Y.

Phœnix Academy, Phœnix, N. Y.

Salamanca Union School, Salamanca, N. Y.; A. B. Davis, Principal.

Glens Falls Academy, Glens Falls, N. Y.; D. C. Farr, Principal.

A collection of minerals has been sent to the Jordan Free Academy, Jordan, N. Y.; John W. Chandler, Principal.

State Hall.

The surrender of room No. 30 of State Hall to the Grand Army of the Republic leaves the Museum without an office room in that building. The books, not taken to the Geological Hall, were removed into the northeast corner room, which is occupied by Mr. J. M. Clarke and Mr. E. Emmons, who are engaged upon the work of the Palæontology. The furniture was removed to the upper floor of the building. The rock-cutting laboratory and the mineral storage continue as mentioned last year, in the basement of the building.

Visitors and Guide-books.

The Museum is open daily, except Sundays, from 9 a. m. to 6 p. m. in the summer, and to 5 p. m. in the other seasons of the year. The number of visitors continues as large as in previous years, varying somewhat with the different seasons. Many of these view the collections simply as natural curiosities and gain but little instruction, but there are some, every day, who come with a more or less definite purpose, who make it their aim to examine some one class of objects, and thus acquire some specific information. Short guide-books or hand-books to some of the collections would be of much assistance to these visitors.

The Museum needs more space and more cases for the proper exhibition of its material, and for the storage, in easily accessible quarters, of its duplicates, which are needed for the illustration of local characters and occurrences, and for distribution and exchanges. Beginning with the principal floor, the mineralogical collection fills the rooms allotted to it, leaving no space for the growth which must take place to be worthy of its place in a State Museum. The entrance hall is already crowded with blocks of stone from the quarries, and there is no available space for the exhibition of cabinet specimens representing all of our quarries, nearly all of which are on hand, packed away in the basement. The same statement is applicable to the iron ores of the State. The collection of these ores, recently obtained, also awaits a place. In the second and third stories the cases are full, and there is no space in which to place the several fine and valuable collections of rocks which belong to the Museum. The construction of two double table cases for the third-story room is necessary to accommodate the palæontological collections acquired during the year. Of course, here, as in the mineralogical rooms, the removal of inferior material and its replacement by better and more valuable specimens affords relief to some extent, and makes an improvement in the exhibition. But for study and convenient reference a museum needs the representation of localities and many local collections, as well as fine examples of species and large general collections. Often these local collections are the most important in the illustration of local characteristics, and the determination of questions of purely scientific as well as of a practical nature. On the top floor of the Museum the space still unoccupied in the floor cases is reserved for the additional birds which are needed to fill the wide gaps in that collection. There is no more case room for exhibition of the skeletons, necessary to illustrate the vertebrate forms, nor for the growing collections of shells, corals and alcoholics. At the present rate of growth the accommodation of the accessions to our collections is a standing problem, which is only half solved. Assuming an increasing rate, as is fitting, solution seems an impossibility within our present limits.

I am respectfully yours,

JOHN C. SMOCK,

Assistant in Charge of the State Museum of Nat. History.

ADDITIONS TO THE COLLECTIONS.

I. ZOOLOGICAL.

By Donation.

Prof. H. A. Ward, Rochester, N. Y.:

One beaver (adult).

Two beavers (young).

One skunk.

One woodchuck, Monroe county, N. Y.

One porcupine (albino), Long Island, N. Y.

Prof. Charles H. Peck:

One specimen of jumping mouse, caught in a trap in the donor's dwelling at Menands Station, Albany, N. Y.

Charles E. Beecher:

Two specimens Amyda mutica, Lesueur, Marietta, Ohio.

John M. Clarke:

Three specimens Gundlachia sp ? Sucker Brook, Canandaigua, N. Y.

By Exchange.

Alfred C. Gatto, Island of Malta:

Fifty-one species land and marine shells from the Island of Malta.

By Purchase.

Prof. H. A. Ward, Rochester, N. Y.:

One specimen Gulo luscus (Wolverine), male.

One specimen Neotoma Floridana (Wood Rat), male, Trego county, Kansas.

One specimen Arvicola pinetorum (Pine Mouse), male, South Carolina.

One specimen Calocephalus vitulinus (Common Harbor Seal), male, Coast of New York.

Two specimens Cystophora cristata (Hooded Seal), male and female, Newfoundland.

One specimen Rangifer carabou (Reindeer), male, Maine.

One specimen Alces machlis (Moose), female, Kansas.

One specimen Martes Americana (American sable or Marten), male, Durango, Colorado.

Five examples of Blaschka's glass models of invertebrates.

G. B. Sowerby, London, England:

One specimen Distichopora coccinea, Kingmill Is.
Two specimens Antillia constricta, Borneo.
One specimen Lophosmilia rotundifolia, Caribbean Sea.
One specimen Desmophyllum Riisei, Caribbean Sea.
One specimen Selensmilia variabilis, Caribbean Sea.
One specimen Dendrophyllia ramea, Singapore.
Two specimens Stylaster sanguineus, Kingmill Is.
One specimen Axohilia Schrammi, Caribbean Sea.
One group Lophosmilia rotundifolia, Caribbean Sea.
One specimen Caryophyllia cyathus, Singapore.
One specimen Retepora cellulosa, Red Sea.
One specimen Caryophyllia maculata, Caribbean Sea.
One specimen Distichopora violacea, Kingmill Is.
One specimen Eschara foliacea, Bristol Channel.
One specimen Hydractinia arborescens, Japan.
One specimen Metalia pectoralis, Bahamas.
One specimen Calcita Schmiedelianus, Mauritius.
One specimen Carpilius maculatus, Mauritius.
One specimen Martesia obtecta (in situ).
One specimen Waldheimia lenticularis, New Zealand.
One specimen Waldheimia cruenta, New Zealand.
Three specimens Megerlia truncata, Corsica.
Three specimens Terebratella rubicunda, New Zealand.
Three specimens Rhynchonella psittacea, Labrador.
Three specimens Kraussia Lamarckiana, Australia.
One specimen Crania anomala, North Britain.
One specimen Cistella Neapolitana, Palermo.
One specimen Argiope cuneata, Mediterranean.
One specimen Kraussia cognata, South America.
One specimen Rhynchonella nigricans, New Zealand.
Two specimens Argiope decollata, Mediterranean.
Two specimens Thecidea Mediterranea, Mediterranean.
One specimen Lingula anatina, Philippines.
One specimen Amnicola Mitchelliana, United States.
One specimen Eucheuma spiciosum, Mauritius.
One specimen Lithamnion polymorphum, Mauritius.

II. GEOLOGY.

By Donation.

Patrick Horan, Medina, N. Y.:

Slab of Medina sandstone with Lingula cuneata, from Medina, N. Y.

A. G. Richmond, Canajoharie, N. Y.:

Palæophycus tubularis, Hall, found in drift near Canajoharie, N. Y.

E. E. Farman, Warsaw, N. Y.:

Block of blue sandstone (12″ x 4″ x 4″) dressed, from the quarry of Warsaw Bluestone Company, Warsaw, Wyoming county, N. Y.

Albion Stone Company:

Six-inch cube of Medina sandstone (dressed), from quarry of the donors, Albion, N. Y.

Nias Hewitt, Amsterdam, N. Y.:

Fifteen specimens of fossils from the quarries of D. C. and N. Hewitt, Amsterdam, N. Y.

D. R. and H. Fogelsönger, Buffalo, N. Y.:

Block of limestone (7″ x 4½″ x 4½″) dressed, from the quarry of donors, Buffalo, N. Y.

Prof. O. C. Marsh, New Haven, Conn.:

Four specimens Murchisonia bowdeni, Saff., and six specimens Tellinomya hartsvillensis, Saff., from Upper Hudson, Moreland, Kentucky.

R. A. Hall, Whitehall, N. Y.:

Slab of Red Slate, (6 feet 3 inches x 19 inches, x 2 inches) from Hatch Hill Quarry, East Whitehall, Washington county, N. Y.

H. A. Ingalsbee, Middle Granville, N. Y.:

Flagging-stone (4 feet square) with marking of Dactyloidites bulbosus, from Middle Granville, Washington county, N. Y.

Yale College Museum, New Haven, Conn.:

One specimen Placenticeras placenta, Dekay Cretaceous, Sage Creek, Dak.

Three specimens Murchisonia turbinata, Brown Middle Devonian, Paffrath, Germany.

One specimen Spondylus spinosus, Sowb., Cretaceous (Chalk), Lewes, England.

One specimen (unidentified) Loc. unknown.

One specimen Cyphosoma konigi, Mantell Upper Chalk, Lewes, England.

One specimen Natica subcostata, Schl., Middle Devonian, Paffrath, Germany.

Three specimens Baculites ornatus, Say, Cretaceous, New Egypt, N. J.

Four specimens Ammonites lautus, Sowb., Gault, Folkestone, England.

Two specimens Scaphites nodosus, var plenus, Owen, Cretaceous, Yellowstone River.

Eight specimens Protocardia (Leptocardia) vara, E. & S., Cretaceous, Milk River, Upper Missouri.

One specimen Macrocheilus arculatus, Phil., Middle Devonian, Paffrath, Germany.

Three specimens Ammonites splendens, Sowb., Gault, Folkestone, England.

One specimen Siphonia tulipa, Zittel, Cretaceous, Warminster, Eng.

Six specimens Belemnites densus, Meek & Hayden, Jurassic, Black Hills, Dakota.

Two specimens Exogyra columbo, Lam., Cretaceous, England.

Three specimens Ventriculites radiatus, Mantell, Chalk, England.

Group of Limopsis parvula, M. & H.; Cretaceous, Yellowstone River.

Group of Protocardia (Leptocardia) subquadrata, E. & S., Cretaceous, Yellowstone River.

N. Cole, Glens Falls, N. Y.:

Two slabs of Hudson River Slate, with Graptolites, from Baker's Falls, N. Y.

H. L. Pierson, Ramapo, N. Y.:

Six inch cube of granite from Ramapo quarry, Rockland county, N. Y.

Bronk Van Slyke, New Baltimore, N. Y.:

Ten specimens of fossil teeth (Equus fraternus, Leidy?) from a mire at New Baltimore, Greene county, N. Y.

St. Lawrence Marble Company:

Cubic foot of dressed marble from the quarry of the donors, Gouverneur, St. Lawrence county, N. Y.

Museu Nacional do Rio de Janeiro:

Twenty-four specimens of Devonian Trilobites from the Ereré, Mont Alegre and Rio Mæcurie district, Province of Para, Brazil, as follows:

One specimen Homalonotus derbyi, Clarke.

Two specimens Phacops braziliensis, Clarke.

One specimen Phacops menurus, Clarke.

Three specimens Phacops (Dalmanites) macropyge.

Six specimens Dalmanites mæcurica, Clarke.

Three specimens Dalmanites tumilobus, Clarke.

Three specimens Dalmanites galea, Clarke.

Four specimens Dalmanites (Cryphæus) paituna, Hartt & Rath.

One specimen Prœtus pullinus, Clarke.

Prof. W. A. Brownell, Syracuse, N. Y.:

Fossils from Trenton Limestone, Jefferson county, N. Y., as follows:

Thirty specimens Camarella hemiplicata.

Twenty-two specimens Camarella ambigua.

Twenty-one specimens Orthis pectinella.

Fifteen specimens Strophomena alternata.

Contributed for use in the preparation of vol. VIII, Palæontology of New York.

J. M. Clarke, Albany, N. Y.:

Nine specimens from Leonard Place, Lark Street, Albany, N. Y. (Hudson Slate), as follows:

Climacograptus bicornis, Hall.

Lingula sp.?

Orbiculoidea sp.?

Three specimens Dadoxylon clarkii, Dawson, Genesee Shales, Bristol, N. Y.

One specimen Frond of Flag or stipe of Fern, Genesee Shales, Bristol, N. Y.

Prof. T. B. Stowell, Cortland, N. Y.:

Two specimens Zygospira Headi, Cincinnati.

Contributed for use in the preparation of vol. VIII, Palæontology of New York.

Prof. W. B. Dwight, Poughkeepsie, N. Y.:

Fossils described in the accompanying letter from Prof. Dwight.

Fossils sent by W. B. Dwight to the New York State Museum, December 9, 1887.

"One slab, covered on weathered surface with Tetradium fibratum in detached and scattered fibres, or in small branchlets. Locality, Trenton limestone ledge at Pleasant Valley, Dutchess county, N. Y. (This locality was discovered by me about six weeks ago; it is the first place in which I have noticed this coral in this county. This Tetradium occurs in a layer associated with an interesting variety of Leperditia and Beyrichia in great numbers.)"

"One slab, eight and one-half inches square, of Quartzite of the 'Olenellus' or Middle Cambrian, filled with fragments of Olenellus, asaphoides (probably), glabellas and cheek spines, Camarellas and

Obolellus (sp.?), and perhaps some tubes of Hyolithellus. (Note: The Olenellus is by a clerical error labelled Thompsoni, probably. It may be Thompsoni, but is more probably 'asaphoides.') Locality, S. end of Stissing Mountain, discovered by C. D. Walcott and W. B. Dwight in a joint trip, and described by W. B. D. in Am. Journ. Sci., July, 1887, p. 30. This Quartzite immediately overlies the Gneiss of the Mountain."

"One piece, 2″ x 2½″ of Limestone, also of the Olenellus horizon, containing two (or more) operculæ of the Hyolithellus micans, one showing the inner and one the outer surface. Locality, Stissing Mountain, S. end, immediately overlying the Olenellus Quartzite."

"One slab, 8″ x 3½″, Potsdam Limestone, filled with fragments of Ptychoparia saratogensis and P. calcifera (Walcott), and Lingulopsis pruniformis. Locality, corner of the Sprackenkill and Varick roads, two miles S. E. of Poughkeepsie, N. Y., described in Am. Journ. Sci., July, 1887, p. 28."

"One small piece same, containing a glabella of P. saratogensis, same locality."

"One small piece, same, containing P. calcifera, a fragmentary glabella, lacking the front margin and occipital spine, but showing the large palpebral lobe and the general shape of glabella and furrows. (The calcifera breaks out in a fragmentary way at this locality — I have no perfect glabella.)"

Five specimens Beyrichia striato-marginalis, Miller, Black River Limestone, Pleasant Valley, Dutchess county, N. Y.

One specimen, the same, Cincinnati Group, Osgood, Indiana.

Geological Museum of the University of Göttingen, through Prof. Dr. A. von Koenen:

One hundred and nine specimens of fossils from the Spiriferen Sandstein of the Hartz Mountains as follows: — In return for a collection of New York species of Devonian Lamellibranchiata.

Five specimens Cyrtodonta declivis.
Two specimens Ledopsis sp.?
One specimen Myoconcha elegans.
Two specimens Avicula jugleri.
Seven specimens Cucullella solenoides.
Five specimens Pterinea concentrica.
One specimen Schizodus œvalis.
Seven specimens Prosocœlus vetustus.
Eight specimens Schizodus elongatus.
One specimen Schizodus inflatus.
One specimen Prosocœlus complanatus.

One specimen Prosocœlus orbicularis.
One specimen Modiomorpha lamellosa.
Three specimens Pleurophorus robustus.
Four specimens Leda Ahrendi.
One specimen Leda securiformis.
One specimen Leda congener.
One specimen Nucula krachtae.
One specimen Nucula cf. krachtae.
One specimen Ledopsis cf. aequalis.
Two specimens Modiola kahlebergensis.
Two specimens Palæoneilo sp.?
One specimen Ledopsis trigona.
One specimen Prosocœlus priscus.
One specimen Pterinea fasciculata.
Five specimens Schizodus sp.?
Two specimens Koenenia lasii.
Three specimens Schizodus obrotundatus.
Two specimens Schizodus carinatus.
One specimen Palæoneilo brevis.
Two specimens Nucula kahlebergensis.
Two specimens Strophomena interstriatus.
One specimen Streptorhynchus umbraculum.
One specimen Streptorhynchus subarachnoides.
Ten specimens Spirifera hysterica.
One specimen Spirifera macroptera.
Seven specimens Chonetes sarcinulata.
Three specimens Bellerophon bisulcatus.
Three specimens Bellerophon trilobatus, var. tumidus.
One specimen Loxonema, sp.?
One specimen Dentalium arenarium.
One specimen Ctenocrinus decadactylus.
Two specimens Cryphæus grotii.

E. B. Knapp, Skaneateles, N. Y.:

Two specimens Eatonia medialis, Lower Helderberg, Clarksville, N. Y.
Twelve specimens Orthis tulliensis, Tully Limestone.
Eleven specimens Rhynchonella venustula, Tully Limestone.
One specimen Crania hamiltoniæ, Hamilton Group, Skaneateles Lake, N. Y.
One specimen Spirifera granulifera, Hamilton Group, Skaneateles Lake, N. Y.
One specimen Spirifera medialis, Hamilton Group, Skaneateles Lake, N. Y.

One specimen Coral, Corniferous Limestone.

Contributed for special use in the preparation of Vol. VIII, Palæontology of New York.

Louis Bevier, Marbletown, N. Y.:

One specimen Homalonotus major.

One specimen Homalonotus Vanuxemi, Marbletown, N. Y.; illustrated in Volume VII, Palæontology of New York.

Yale College Museum, New Haven, Conn.:

Fossils from the Jurassic of Solenhofen, Bavaria, as follows:

Two specimens Hefriga serrata, Munst.
Two specimens Meochirus longimanus, Schloth.
Three specimens Limulus walchi, Des.
One specimen Eryma leptodactylina, Germ.
One specimen Ammonites steraspis, Opp.
Two specimens Aptychus imbricatus.
One specimen Eryon arctiformis, Schloth.
One specimen Aeger tipularius, Schloth.
Two specimens Eryma minuta, Schloth.
One specimen Palinurina pygmæa, Munst.
Two specimens Penæus speciosus, Munst.
Twenty specimens Aptychi of Ammonites latus, Park.
Three specimens Aptychi of Ammonites euglyptus, Opp.
Three specimens Ammonites lithographicus, Opp.
Two specimens Belemnitella mucronata, Schloth., Cretaceous (Upper Chalk) Mæstricht.
One specimen Glyptocrinus nealli, Hall, Hudson River Group, Cincinnati, O.
Three specimens Belemnitella mucronata, Schloth., Meudon, France.
Two specimens Belemnites fusiformis, Park., Middle Jurassic, Burgheim, Baden, Ger.
Nine specimens Calymene tuberculata, Brünn, Upper Silurian, Gothland.
Three specimens Meristina didyma, Dal., Upper Silurian, Gothland.
One specimen Apiocrinus rotundus, Müll., Great Oolite (Bradford Clay), Bradford.
Fourteen specimens Palæocyclus porpita, Linn., Upper Silurian, Gothland.
Two specimens Ammonites jason, Rein., Oxford Clay, Jurassic, Wiltshire, England.
Three specimens Encrinus liliiformis, Müll., Triassic, Brunswick, Germany.

Eleven specimens Terebratula biplicata, Sowb., Cretaceous, Berklingen, Brunswick, Germany.

Three specimens Lumbricaria intestinum, Munst., Upper Jurassic, Solenhofen, Bavaria.

One specimen Teredo tibialis, Morton, Cretaceous, Harrison, New Jersey.

Ten specimens Crania ignabergensis, Retz., Cretaceous, Ignaberg, Sweden.

Two specimens Gryphæa vesicularis, Cretaceous, New Jersey.

Three specimens Stephanophyllia nysti, Milne-Edwards, Miocene-Tertiary, Antwerp, Belgium.

Two specimens Exogyra costata, Say, Cretaceous, Columbus.

One specimen Bythinella gregaria, Meek, Pacific Springs, Wyoming Territory.

Three specimens Lumbricaria filaria, Munst., Upper Jurassic, Solenhofen, Bavaria.

One specimen Terebratula biplicata, Sowb., Great Oolite, Calrados, France.

One specimen Ostrea deltoidea, Sowb., Jurassic, Oxford Clay, Wiltshire, England.

Three specimens Calceola sandalina, Lam., Devonian, Eifel, Germany.

Thirteen specimens Turbinoidea compressa, Lam., Eocene-Tertiary, Grignon, France.

Four specimens Salterella billingsi, Safford, Trenton Limestone, Middle Tennessee.

One specimen Coleolus tenuicinctum, Hall, Hamilton Group, Yellow Springs, Ohio.

By Deposit.

Louis Bevier, Marbletown, N. Y.:

One specimen Dalmanites myrmecophorus, from Kingston, N. Y.

By Collection.

One thousand specimens, mostly Brachiopods, from the Corniferous and Hamilton Groups of Ontario and Genesee Counties, collected by J. M. Clarke and Jacob Van Deloo.

One thousand one hundred specimens of rocks and miscellaneous fossils from the Taconic, Chazy, Birds-eye, Trenton and Hudson River formations of North-eastern New York and North-western Vermont, collected by Dr. C. Rominger.

By Purchase.

H. T. Woodman, New York city:

Four specimens Acervularia davidsoni, E. & H., Hamilton Group, Iowa.

Four specimens Favosites hemisphericus, Troost, Hamilton Group, Iowa.

One specimen Favosites emmonsi, Rominger, Hamilton Group, Iowa.

One specimen Cænostroma incrustans, M. & H., Hamilton Group, Iowa.

One slab of Potsdam Sandstone (4 feet 9 inches x 3 feet 6 inches) with Ripple marks, from Keeseville, N. Y.

Ward and Howell, Rochester, N. Y.:

One specimen Macropetalicthys Sullivanti.
One specimen Diplomystus altus.
One specimen Ammonite.
One specimen Pentacrinus, sp. ?
One specimen Fish-tail. Gen. ? sp. ?
One specimen Icthyosaurus.
One specimen Platystrophia biforata.
One specimen Spirifera acuminata.
Seven specimens Spirifera Orestes.
Four specimens Spirifera Littoni.
Five specimens Spirifera Oweni.
Seven specimens Spirifera euryteines.
Three specimens Rhynchonella nympha.
Two specimens Rhynchonella tula.
Three specimens Rhynchonella henrici.
Two specimens Trematis punctostriata.
One specimen Trematospira marginalis.
Two specimens Retzia haidingeri.
Three specimens Uncites gryphus.
Two specimens Stringocephalus burtini.
One specimen Productus giganteus.
Two specimens Dielasma bovidens.
Two specimens Camarophoria megaera.
Twenty-two specimens Dielasma elongata.
Six specimens Dielasma elongata var. complanata.
Sixty specimens Camarophoria Schlotheimi.
Forty specimens Koninckina Leonhardi.
Eight specimens Terebratula linguata.
Two specimens Triplesia ambigua.

Eight specimens Centronella Guerangeri.
Thirteen specimens Lingula prima.

G. K. Greene, New Albany, Ind.

Purchased for use in the preparation of the Palæontology of New York, Vol. VIII.
One hundred specimens Spirifer Oweni.
One hundred specimens Spirifer varicosa.
Seventy-five specimens Spirifer segmenta.
One hundred specimens Atrypa reticularis.
Fifty specimens Rhynchonella tethys.
Twenty-five specimens Productella spinulicosta.
Thirty specimens Athyris vittata.
Fourteen specimens Cyrtina hamiltonensis.
Fifty specimens Spirifera gregaria.
Four specimens Spirifera acuminata.
Various specimens Pentamerus.
Miscellaneous Brachiopoda of the St. Louis group.
Miscellaneous Brachiopoda of the Niagara group of Louisville.

Prof. Snow, University of Kansas, Lawrence:

Cretaceous plants from the Dakota Sandstone of Ellsworth County, Kansas, as follows:

One specimen Sterculia Snowii, Lesq.
One specimen Avalia sapertanea, Lesq.
One specimen Viburnum robustum, Lesq.
One specimen Rhamnus inaequilateralis, Lesq.
One specimen Rhamnus apiculatus, Lesq.
One specimen Populus kansasensis, Lesq.
One specimen Ilex dakotensis, Lesq.
One specimen Hedera orbiculata, Lesq.
One specimen Betulites flabelliformis, Lesq.
One specimen Betulites vestii, var. latifolia.
One specimen Betulites vestii, var. obtusa.
One specimen Sassafras acutilobum, Lesq.
One specimen Sassafras cretaceus, Newb. var. obtusus, Lesq.
One specimen Greviopsis Haydeni, Lesq.
One specimen Diospyros rotundifolia, Lesq.

George F. Kunz:

A collection of 160 specimens of rocks illustrating the types and varieties of rocks occurring on New York Island.

F. H. Butler, London, Eng.:

Two specimens Fusus contrarius.
Two specimens Planorbis rotundus.

Two specimens Limnea longiscata.
Two specimens Paludina lenta.
Two specimens Nucula simulatus.
Three specimens Vermetus Borgnoriensis.
Two specimens Fusus regularis.
One specimen Gervillia anceps.
One specimen Trigonia clavellata.
One large group Trigonia clavellata.
One specimen Trigonia Etheridgii.
One specimen Trigonia costata.
One specimen Trigonia navisii.
Two specimens Macrodon hirsonensis.
Two specimens Pholadomya Murchisoni.
One specimen Pteroperna costulata.
One specimen Purpuroidea Morrisii.
One specimen Productus giganteus.
One specimen Streptorhynchus crenistria.
Three specimens Anthracosa robusta.
One specimen Pterinea retroflexa.
One specimen Glassia (sp. indet.).
Two specimens Rhynchonella acuta.
Two specimens Belemnites tubularis.
Two specimens Belemnites apicicurvatus.
One specimen Belemnites digitalis.
One specimen Nautilus lineatus.
One specimen Ammonites Blagdeni.
One specimen Ammonites Brookii.
Two large Ammonites (Sp. indet.)
Three specimens Cornulites serpularius.
Three specimens Choanites Konigi (cut and polished).
One specimen Lonsdaleia floriforme.
One specimen Lithostrotion Portlockii.
One specimen Halysites catenularia.
Two specimens Favosites Forbesii.
One specimen Acervularia luxurians.
Two specimens Thamnastrea arachnoides.
One specimen Marsupites ornatus.
One specimen Apiocrinus Parkinsonii (head, root and section).
Two specimens Pseudodiadema hemispherica.
Two specimens Cidaris florigemma.
Two specimens Hemipedina Beckii.
Four specimens Acrosalenia spinosa.

Two specimens Echinus bigranulatus.
Two specimens Echinoconus conicus.
One specimen Echinocorys vulgaris.
One specimen Micraster cor-anguinum.
One specimen Cidaris hirudo.
One specimen Salenia Austeni.
One specimen Cardiaster latissimus.
One specimen Palæocoma tenuibrachiata.
One specimen Nummulites lævigatus.

III. MINERALOGICAL.

BY DONATION.

O. J. Phelps, Willsborough, N. Y.:

Calcareous Tufa, one-half mile S. E. of Willsborough, N. Y.

J. M. Clarke, Albany, N. Y.:

One specimen Molybdenite in Triassic Sandstone, Larrabee's quarry, Mt. Holyoke, Mass.

One bottle Garnet sand, composed of dodecahedral crystals, island near Yarmouth, N. S.

Two specimens Microcline, Leverett, Mass.

One specimen Chlorophanite, Gill, Mass.

One specimen Gypsum from boiler Chesapeake Bay steamer.

One specimen Asbestus, Duchy of Parma.

And a series of fifty-eight specimens representing the mineral locality in the town of Pelham, Mass., as follows:

Epidote.
Asbestus.
Tourmaline.
Schorl.
Biotite.
Biotite changing into Vermiculite.
Biotite inclosing Amphibolite.
Biotite changing into Ripidolite.
Pelhamine.
Andesite.
Anorthite.
Amphibolite, passing into Steatite.
Vermiculite.
Tourmaline (decomposing).
Zoisite.
Allanite.
Ilmenite.

Serpentine.
Talc.
Corundum.
Tremolite.
Apatite.
Chromite.
Actinolite.

H. D. Graves, Ausable Forks, N. Y.:

A large block of coarse crystalline magnetic iron ore from Palmer Hill Mines, Clinton county, N. Y.

H. J. Davis, Davis, Mass.:

One block Iron Pyrites.

Five specimens Chalcopyrite from Davis Mine, Franklin county, Mass.

George F. Kunz, Hoboken, N. J.:

Cast of Iron Meteorite, Cabin Creek, Johnson county, Arkansas, prepared by J. C. Hendley.

Prof. T. Rupert Jones, London, England:

One specimen Diamond matrix and one nodule of Peridotite, Kimberly Mine, South Africa.

By Exchange.

F. L. Nason, New Brunswick, N. J.:

One specimen Diaspore, Chester, Mass.
One specimen Tetrahedrite Liskeard, England.
One specimen Graphite, Ticonderoga, N. Y.
One specimen Orpiment, Persia.
Four specimens Diaspore, Chester, Mass.
One specimen Emery.
One specimen Stibnite, Japan.
Five specimens Spodumene, Huntington, Mass.
One specimen Menilite, Lee, Mass.
One specimen Hexagonite, Edwards, N. Y.
One specimen Feldspar, New York.
One specimen Brown Tourmaline, Gouverneur, N. Y.
One specimen Black Tourmaline, Huntington, Mass.
One specimen Black Tourmaline, Chester, Mass.
Twelve clusters Quartz crystals, New Baltimore, N. Y.
One specimen Galenite, Galena, Illinois.
One specimen Dinchite, Lee, Mass.
One specimen Quartz (cluster), Middleville, N. Y.
One specimen Pyromorphite, Phœnixville, Pa.
One specimen Pyrophyllite, Graves Mt., Ga.

By Collection.

J. Van Deloo:

Lot of magnetic iron ore from Barton Hill Mine, Mineville, N. Y.

By Purchase.

Tiffany & Co., New York city:

One Green Garnet (cut), Siberia.

One Amethyst (cut), South Carolina.

One Jadeite (cut), China.

Geo. F. Kunz, Hoboken, N. J.:

Meteroic iron from Toluca Valley, Mexico, as follows:

One specimen, weight eighteen pounds.

One specimen, weight three pounds.

One specimen, weight fifteen pounds.

One specimen cut and showing Widmanstätten figures.

A collection of minerals found occurring naturally on New York island, 193 specimens.

A collection of minerals from Westchester county, 186 specimens.

Four large groups of fluorites (green) from St. Lawrence county.

ETHNOLOGICAL DEPARTMENT.

Donation.

A. G. Richmond, Canajoharie, N. Y.:

Stone mortar 9″ x 7″ x 2,″ Mohawk Valley, N. Y.

Six pitted stones, Mohawk Valley, N. Y.

Seven stone fishing-net sinkers, Mohawk Valley, N. Y.

Collection of mammalian vertebræ and bones, and shells of Anodonta, found on the site of an Indian village, Mohawk Flats, N. Y.

I. P. Bishop, Chatham, N. Y.:

Three hundred and nine arrow-points from Silver Lake, near Perry, N. Y. Collected by the donor from a single caché.

C. H. Smith, Glenville, N. Y.:

One arrow-point ploughed up at Glenville, Schenectady county, N. Y., by the donor.

Sidney Hay, Saratoga, N. Y.:

The following specimens collected by the donor in the neighborhood of Saratoga Lake, N. Y., viz.:

Two stone pestles.

Two stone hatchets.

One stone gouge.

ADDITIONS TO THE LIBRARY.

By Donation.

United States Patent Office:

Official Gazette, Vols. 39 and 40, title page and index; Vol. 41, Nos. 8 to 13, title page and index; Vol. 42, Nos. 1 to 13, title page and index; Vol. 43, Nos. 1 to 13; Vol. 44, Nos. 1 to 13; Vol. 45, Nos. 1 to 7.

Alphabetical List of Patentees and Inventions for Quarter ending June 30, 1887; September 30, 1887; December 31, 1887; March 31, 1888.

Annual Report of the Commissioner of Patents for the year 1887.

United States War Department:

Monthly Weather Review for January, March to October, December, 1881; May and June, 1882; February, March, May to December, 1883; March to December, 1884; May and November 1885; January, March to August, October to December, 1886; September to December, 1887; February to August, 1888.

Tornado Circular No. 1, new series:

Character of the Weather Conditions at Albany as shown by observations of past fourteen years for July, fifteen years for August.

United States Bureau of Education:

Report of the Commissioner of Education, 1885–86.

Circulars of Information, 1887, Nos. 2, 3.

United States Treasury Department:

Report of the Commissioner of Navigation, 1885.

Superintendent Public Documents:

Annual Report regarding the Receipt and Distribution of Public Documents on behalf of the Government (U. S.) by the Department of the Interior.

United States Fish Commission:

The Fishery Industries of the United States. By G. Brown Goode and Associates.

The Author:

Mineral Resources of the United States, 1886. By David T. Day.

United States Geological Survey:

Mineral Resources of the United States, 1886. By David T. Day.

The same for calendar years 1882–1886. By David T. Day.

Atlas to Accompany a Monograph on the Geology and Mining Industry of Leadville, Colorado, 1883. By Samuel Franklin Emmons.

Hon. Wm. M. Evarts:

Tenth Census of the United States, Vol. XII, Mortality and Vital Statistics, Part II.

Plates and Diagrams accompanying Part II, Vol. XII, United States Census.

Compendium of the Tenth Census, 1880, Parts I and II.

The Survey:

Geological Survey of Ohio, Vol. II, Chart No. 1, Sections of the Coal Measures in Western Pennsylvania and Northern Ohio, by J. S. Newberry; Vol. II, Chart No. 2, Sections of the Lower Coal Measures of Northern and Central Ohio, by J. S. Newberry; Vol. II, Chart No. 3, Sections of the Coal Measures on the Ohio River, between Smith's Ferry and Brown's Station, by J. S. Newberry and Henry Newton; Vol. II, Chart No. 4, Sections of the Coal Measures on the Ohio River, between Brown's Station and Moundsville, by J. S. Newberry and Henry Newton.

Map No. 11 of Grouped Sections; Washington county. By E. B. Andrews and W. B. Gilbert.

Map No. 12 of Grouped Sections of Noble and South Half of Guernsey counties. By E. B. Andrews and W. B. Gilbert.

Map No. 13 of Grouped Sections of Monroe county. By E. B. Andrews and W. B. Gilbert.

Map No. 14 of Grouped Sections of South Half of Belmont county. By E. B. Andrews and W. B. Gilbert.

The Author:

Copyright and Patents for Inventions, Vol. I, Copyright; Vol. II, Patents. By R. A. Macfie.

Verities in verses, combining Mottos and Motives; Brotherhood; Fellowship and Acting Together; New Covenant Ordinances and Order. By R. A. Macfie.

Charles Wachsmuth:

Hybocrinus, Hoplocrinus and Baerocrinus. By Wachsmuth and Springer (Am. Journ. Sci.).

Revision of the Palæocrinoidea. By Wachsmuth and Springer. Part I, Part II, Part III, First Section; Part III, Second Section (Proc. Acad. Nat. Sci., Philada.).

Remarks on Glyptocrinus and Reteocrinus, two Genera of Silurian Crinoids. By Wachsmuth and Springer (Am. Journ. Science).

The Summit Plates in Blastoids, Crinoids and Cystids, and their Morphological Relation. By Wachsmuth and Springer (Proc. Acad. Nat. Sci., Philada.)

C. E. Beecher:

Note sur Phasganocaris, Nouveau Phyllocaride de l' Etage F.—f. 2, en Bohême. Par Ottomar Novak.

Studien an Hypostomen Böhmischer Trilobiten, No. IV. Von. Dr. Ottomar Novak.

Nouveau Crustacé Phyllocaride de l' Etage, F.—f. 2, en Bohême. Par Ottomar Novak.

A method of preparing, for Microscopical Study, the Radula of small species of Gasteropoda. By C. E. Beecher.

Sanderson Smith:

Catalogue of the Mollusks in the Vicinity of Mohawk, N. Y. By James Lewis, M. D. (Proc. Phila. Acad. Sciences).

On the Lingual Dentition, Jaw and Genitalia of Carelia, Onchidella, and other Pulmonata. By W. G. Binney (Proc. Phila. Acad. Sci.).

List of Deep-water and Surface Mollusca taken off the East Coast of the United States by the Fish Commission Steamers Fish-Hawk and Albatross, 1880–1883. By A. E. Verrill.

Remarks on some Species of Paludina, Amnicola, Valvata and Melavia. By James Lewis, M. D. (Proc. Phila. Acad. Sci.).

Catalogue of the Mollusca of Little Gull Island, Suffolk county, N. Y. By Sanderson Smith (Ann. of Lyceum, 1865).

Catalogue of the Mollusca of Staten Island, N. Y. By J. W. Hubbard and Sanderson Smith (Annals of the Lyceum, 1865).

The Editor:

Honduras Progress, July 5, 12, 19 and 26, 1888.

The Museum:

Anales del Museo Nacional Republica de Costa Rica, Tomo I, Ano, 1887, Primera Parte, Segunda Parte, and Primera Parte and Segunda Parte combined.

The Author:

The Taconic of Georgia and the Report on the Geology of Vermont. By Jules Marcou. (Mem. Bost. Soc. Nat. Hist., March, 1888.)

State Board of Health of New York:

Eight Annual Report, 1888.

City Auditor:

Annual Report of the City Auditor (Boston) for the financial year, 1887–1888.

The Author:

Notes on the Geology of Johnson County, Iowa. By Clement L. Webster.

Notes on the Rockford Shales. By Clement L. Webster.

On the Glacial Flow in Iowa. By Clement L. Webster. (All ext. from Am. Naturalist.)

New York State Legislative Record, 111th Session, 1888.

The Museum:

Seventeenth Annual Report of the Curators of the Museum of Wesleyan University.

George H. Cook, State Geologist, New Jersey:

The Relief Map of the State of New Jersey, on a scale of five miles to an inch.

Prof. J. C. Smock:

Transaction of the Vassar Brother's Institute and its Scientific Section, 1884–1885.

The Society:

Transactions of the Jefferson County (N. Y.) Historical Society, 1886–1887.

Agricultural Department of France:

Bulletin, Documents, Officiels, Statisque — Rapports — Comptes Rendus de Missions en France et à l'Etrangere, Sixieme Année, Nos. 6 and 7.

The Committee:

Thirty-fifth Annual Report of the Committee of the Free Public Library and Museum, and Walker Art Gallery of the City of Liverpool.

Prince Albert of Monaco:

Campagnes Scientifiques du Yacht Monegasque l' Hirondelle — Troisiéme Année, 1887 — Excursions Zoölogiques dans les Isles de Fayal et de San Miguel (Açores). Par Jules de Guerne.

The Author:

The Characeæ of America. By T. F. Allen. Part I.

The Museum:

Accessions to the Indian Museum during the Quarter ending March 31, 1887.

State Mineralogist:

Seventh Annual Report of the State Mineralogist of California for the year ending October 1, 1887. (2 copies.)

The Author:

Memoranda on a Collection of Fishes from the Ozark Region, Missouri. By R. Ellsworth Call.

The Publisher:

American Monthly Microscopical Journal, Vol. IX, No. 4.

Bausch & Lomb Optical Co.:
Microscope Catalogue.

The Author:
The Butterflies of the Eastern United States and Canada. By S. H. Scudder (sample copy).

By Exchange.

The Society:
Bulletin de la Sociéte Imperiale des Naturalistes de Moscou, Année, 1887, Nos. 3 and 4; Année, 1888, Nos. 1 and 2.
Beilage zum Bulletin, Deuxiéme Serie, Tome I, 1887, Erste hälfte, Zweite hälfte.

The Author:
Notes on the Land Mollusca of the Washburn College Biological Survey of Kansas. By R. E. Call.
On a new Post Pliocene Limnead. By R. E. Call.
On the Genus Campeloma, Rafinesque, with a Revision of the Species Recent and Fossil. By R. E. Call.
On the Quaternary and Recent Mollusca of the Great Basin, with descriptions of New Forms. By R. E. Call.
Fossils of the Iowa Loess. By R. E. Call.
Hartmann on Partula. By R. E. Call.
A Geographic Catalogue of the Unionidæ of the Mississippi Valley. By R. E. Call.
The Loess in Central Iowa. By R. E. Call.
Contributions to a knowledge of the Fresh-water Mollusca of Kansas, Nos. III, IV. By R. E. Call.
On Certain Recent, Quaternary and New Fresh-water Mollusca. By R. E. Call.
Memoranda on a Collection of Fishes from the Ozark Region, Missouri. By R. E. Call.
Note on the Ctenidium of Unio aberti, Conrad. By R. E. Call.
On Pyrgulopsis, a new Genus of Rissoid Mollusk, with descriptions of two new forms. By R. E. Call and Harry A. Pilsbry (2 copies).
Description of a new Strepomatid Mollusk of the Genus Goniobasis. By R. E. Call.
Note on Succinea campestris and Succinea aurea. By R. E. Call.
A new Texan Unio. By R. E. Call.
Note on the Geographical Distribution of Certain Mollusks. By R. E. Call.

Charles S. Prosser:
Bulletin of the United States Geological Survey, No. 33. Notes on the Geology of Northern California.

Report of the United States Commissioner of Agriculture, 1885.
Geological Survey of Alabama. Report of Progress, 1879, 1880.
The Section of the Morrisville Well and the Upper Hamilton of Chenango and Otsego Counties. By Charles S. Prosser.

Library University of Illinois:
Miscellaneous Essays on Economic Entomology. By the State Entomologist (S. A. Forbes) and his Entomological Assistants.
On the Noxious Insects of the State of Illinois; 2d, 3d, 4th Annual Reports. By William Le Baron, State Entomologist.
The Food of Birds — The Thrush Family. By S. A. Forbes.
On a Contagious Disease of Caterpillars. By S. A. Forbes.
The Lake as a Microcosm. By S. A. Forbes.
Bulletin of the Illinois State Laboratory of Natural History. Vol. II, Articles 1 to 7, inclusive; Vol. III, Articles Nos. 1, 2, 3.
Supplementary Note on the Food of the Bluebird. By S. A. Forbes.
The Blind Fishes and their allies. By S. A. Forbes.
Illinois Museum of Natural History — The Natural History of Illinois. Bulletins No. 1, No. 2, No. 6.
Transactions of the Department of Agriculture of Illinois. Vol. 22, 1884.

The Survey:
The Geological and Natural History Survey of Minnesota. Bulletins Nos. 2, 3, 4; Fifteenth Report for the year 1886.

New York Academy of Sciences:
Annals, Vol. IV, Nos. 3 to 8, 1888, inclusive; Transactions, Vol. VI, 1886–1887; Vol. VII, Nos. 1 to 8; Annals of the Lyceum of Natural History, Vols. V, VI, VII, VIII, IX, XI.

Johns Hopkins University:
Studies from the Biological Laboratory. Vol. IV, Nos. 3 and 4.
On Insects and Arachnids. By Adam Todd Bruce.

The Museum:
Bulletin of the Museum of Comparative Zoölogy at Harvard College. Vol. XIII, Nos. 9, 10; Vol. XVII, No. 1.

The Gesellschaft:
Sitzungsberichte der Kongl. Böhmischen Gesellschaft der Wissenschaften, 1886, 1887. Jahresbericht (of the same).

Prof. Edw. M. Shepard:
Engineering Department United States Army. Report upon Geographical and Geological Explorations and Surveys west of the One-hundredth Meridian. Vol. 5, Chapters 4 and 5, Zoölogy.

Geological Survey of Missouri. Report for 1874? (Chapter XII, Howard County to end, p. 179 to p. 734 and index.)

Report of Geological Survey of Missouri, including Field Work of 1873–1874.

United States Geological and Geographical Survey of the Territories. Bulletins Nos. 1 to 4 inclusive.

Geological Report of Minnesota, 1880.

The Society:

Bulletin of the American Geographical Society. Vol. XIX, No. 4 and Supplement; Vol. XX, Nos. 1, 2.

Natural History Society of Montreal:

Canadian Record of Science. Vol. 3, Nos. 1 to 4.

The Author:

Homoptera Indica. By E. T. Atkinson.

The Club:

Bulletin of the Torrey Botanical Club. Vol. 14, No. 12; Vol. 15, Nos. 1 to 11.

The Institute:

Proceedings of the Canadian Institute, Toronto. Vol. XXIII, No. 149; Vol. XXIV, No. 150.

Annual Report, 1886–1887.

The Institution:

Annual Report of the Board of Regents of the Smithsonian Institution to July, 1885, Part II. Smithsonian Miscellaneous Collections. Vols. XXXI, XXXII, XXXIII.

The Museum:

Bergens – Museums Aarsberetning, 1886.

The Commission:

Communicacoes da Commissao dos Trabalhos Geological de Portugal. Tom. I, Fasc. II, 1885–1887.

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A CATALOGUE

OF THE

Published Works of James Hall, LL.D.

1836-1882.

COMMUNICATED BY DR. DAVID MURRAY.

[WITH SUPPLEMENTARY LIST TO 1888.]

CATALOGUE.

PART I.

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94. Notes and Observations upon the Fossils of the Goniatite Limestone in the Marcellus Shale of the Hamilton Group, in the Eastern and Central parts of the State of New York, and those of Goniatite Beds of Rockford, Indiana; with some analogous forms from the Hamilton Group proper. Ibid., pp. 95–112.
95. Note upon the Trilobites of the Shales of the Quebec Group in the town of Georgia, Vermont. Ibid., pp. 113–119.
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247. Plates and Explanations. Published in advance of Palæontology of New York. Vol. VI, plates XXV, XXVII, XXIX, XXX–XXXII, XL, XLI, XLIV, XLV, XLVIII, L, LI, LIII. 5th Annual Report State Geologist, 1886, 8vo.
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REPORT OF THE BOTANIST.

REPORT OF THE BOTANIST.

To the Honorable the Board of Regents of the University of the State of New York:

GENTLEMEN.—I have the honor of communicating to you the following report:

Specimens of plants for the State Herbarium have been collected by the Botanist during the season now closing, in the counties of Albany, Rensselaer, Saratoga, Essex, St. Lawrence, Jefferson, Lewis, Ulster, Orange and Suffolk. Specimens contributed by correspondents were collected in the counties of Orleans, Chenango, St. Lawrence, Rensselaer, Richmond and Queens.

Specimens representing two hundred and sixty-eight species of plants have been added to the Herbarium during the year, of which two hundred and fifty-three were collected by the Botanist and fifteen were contributed. Of the former, one hundred and eight are new to the Herbarium. The others are improved specimens, or such as exhibit some feature or variation in the species which was not well shown by the specimens already possessed. Of the contributed specimens, eleven species were not before represented, thus increasing the number of species now represented by one hundred and nineteen. Among these are forty species of fungi considered new to science. A list of the species of which specimens have been added is marked A.

Twenty-one persons have contributed specimens. Among the contributions are many extra-limital species not included in the foregoing enumeration. A list of the contributors and of their respective contributions is marked B.

A record of species not before reported, together with descriptions of such as are deemed new, is marked C.

Remarks concerning species previously reported, a record of new localities of rare plants and descriptions of varieties, will be found in a subdivision marked D.

Descriptions of New York species of Clitopilus are given in a section marked E.

The climatic conditions in the early part of the season were very unfavorable to the production of fleshy fungi. Very few even of the most common and ubiquitous species were seen. Dry weather prevailed, and the slight rains which fell were followed by such high winds and low temperature that few of these fungi could grow. But with the advent of more copious rains later in the season, an abundant crop of numerous species appeared. A visit to Essex county at this time was rewarded by large additions to the collection, many of which were new to the Herbarium. Places from which the timber had been cut many years ago and in which beautiful groves of young spruce, tamarack and balsam-fir trees had since grown were especially prolific, though everywhere on the wooded hills and in the mossy tamarack swamps the mycological flora was rich and varied. In these groves three esculent species were noticeable by reason of their great profusion. In every direction and at frequent intervals the brownish-red and tawny-red hues of groups and tufts of *Tricholoma imbricatum*, *T. vaccinum* and *T. transmutans* could be seen. They might have been gathered by bushels. But for the ignorance of the inhabitants concerning these plants, their tables and those of the large boarding houses there might have been supplied with an abundance of the novel but good and wholesome food which these three species would have furnished for the slight labor of gathering them. And other edible species were by no means rare or limited in quantity. *Geoglossum vitellinum*, a small but beautiful and tender fungus grew in such profusion in low woods where the ground is covered with moss, that it was tested as to its edible qualities and found to be very good. *Clitocybe media*, a new species, and *Tricholoma transmutans* were also tested for the first time. I have no hesitation in adding these three species to the list of edible fungi.

While collecting in this region the difference in the liability of certain kinds of wood to fungous attack was very apparent. Old stumps, prostrate trunks and decaying wood of spruce and balsam were inhabited by many species of fungi, while the wood and prostrate trunks of the tamarack and arbor-vitæ or white cedar in similar situations were almost entirely free from them. Thus

nature teaches, and the observant mycologist might affirm *a priori*, that the wood of these trees is much more durable than that of the spruce or of the balsam. The frequent use of spruce for fence posts in that region seems strange and unprofitable since tamarack is plentiful there and might be obtained almost as easily and as cheaply as spruce.

The beautiful rhodora, *Rhododendron Rhodora*, is a rare shrub in our State, and was but imperfectly represented in the Herbarium. Having learned of its occurrence on Sam's Point, a high rocky promontory-like spur of the Shawangunk mountains, lying about five miles east of Ellenville, I visited that locality in quest of specimens of it. Its usual habitat is "cool bogs," but here it was found growing in rocky rather than boggy places, though it was especially plentiful in a station not far from the shore of a small lake on the mountain. It was too late in the season to obtain its flowers which appear before the leaves are developed, but fine foliage and fruit-bearing specimens were secured. The broad plateau-like summit of the mountain proved to be an interesting botanical locality. Much of the vegetation is of a shrubby character. About sixty species of plants were noted, of which ten, or one-sixth of the whole, belong to the Heath family. The huckleberry, *Gaylussacia resinosa*, grows here in great profusion, and also the dwarf blueberry, *Vaccinium Pennsylvanicum*. These and the high-bush or swamp blueberry, *Vaccinium corymbosum*, afford a generous crop of fruit, in the picking of which some of the inhabitants of the vicinity were engaged at the time of my visit. The variations in the dwarf blueberry are worthy of notice. The typical form is common and the narrow-leaved dwarf variety is also present. There is also a form with pale green or glaucous foliage, approaching *V. vacillans* in appearance, but apparently distinct from it. This sometimes bore black shining berries destitute of bloom, thus approaching the variety *nigra*. Again it bore berries with the usual bloom, but of an oval shape, being longer than broad. Both this species and the huckleberry manifested their hardy character, their ability to grow under adverse circumstances, and their readiness to occupy all available space by frequently growing in long rows or lines, following the directions of crevices in the surface of the rock. A little soil had accumulated in these crevices, and this enabled these plants to maintain their foothold. These rows of shrubs curve and some-

times cross each other at various angles, and thus present a curious and somewhat artificial aspect. In a few boggy places the cranberry, *Vaccinium macrocarpum*, was growing.

The summit of the mountain is somewhat isolated and is exposed to sweeping winds from every direction. This, together with an altitude of 2,000 feet or more, and a very thin soil, must render the place a trying one for all except the most hardy species of plants. There is a marked tendency to dwarf development. The pitch pines have a starved misshapen appearance and bear cones when but one or two feet high. Specimens of chokeberry but eight or ten inches high were in fruit; also, the shad bush at two feet and the mountain holly at one foot. The narrow-leaved variety of the dwarf blueberry bore fruit though but three or four inches high. The coldness of the station is indicated by the presence of species usually found in more northern latitudes or in more elevated places. The rhodora already mentioned, the trifid rush, *Juncus trifidus*, the three-toothed cinquefoil, *Potentilla tridentata*, the slender cotton grass, *Eriophorum gracile*, and the Greenland sandwort, *Arenaria Greenlandica*, are examples of this kind. That which is manifestly a principle in nature receives confirmation here and is noticed because the existence of such a principle is sometimes overlooked. The principle to which reference is made is that a plant whose strength or vital force has been weakened or impaired by any cause, is more liable to suffer from the attacks of parasitic fungi than one whose vigor is unimpaired. The sheep laurel, *Kalmia angustifolia*, was badly infested by *Dothidella Kalmiæ*, a fungus which attacks the branches of the living plant and causes them to increase in diameter and become blackened. Their leaves do not attain half their usual size and the branch eventually dies. This fungus is a rare one, and I have never seen vigorous healthy appearing plants affected by it. *Rhytisma Canadensis* is a more common fungus that attacks the foliage of the mountain holly, but rarely do its attacks equal in severity those on the plants of Sam's Point. This shrub here shows by its dwarf development that the conditions of growth are unfavorable and that its vigor is impaired. Scarcely a clump of the bushes was seen whose leaves were not excessively spotted by the blackened swellings of this fungus. The wild black cherry, *Prunus serotina*, in other places furnishes an illustration of this same principle. On Long Island, in light

sandy soil about Manor and Eastport, where it makes an unthrifty straggling growth, its branches are badly infested by the black knot fungus, *Plowrightia morbosa*, but in those parts of the State where the soil is richer in the elements of plant food, and these trees make a healthy, vigorous growth, they are almost entirely free from this fungus. The practical application of this principle is plain. If we would have our cultivated and useful plants as free as possible from the attacks of injurious parasitic fungi, we must maintain their constitutional vigor and give them a full supply of plant food.

Respectfully submitted,

CHARLES H. PECK.

Albany, *December* 10, 1888.

(A.)

PLANTS ADDED TO THE HERBARIUM.

New to the Herbarium.

Hieracium præaltum *Vill.*
Penstemon lævigatus *Soland.*
Physalis Peruviana *L.*
Quercus heterophylla *Mx.*
Q. Rudkini *Britton.*
Setaria verticillata *Bv.*
Apera spica-venti *Bv.*
Equisetum litorale *Kuhl.*
Lepiota augustana *Britz.*
Tricholoma imbricatum *Fr.*
T. subacutum *Pk.*
T. silvaticum *Pk.*
T. nobile *Pk.*
T. brevipes *Bull.*
T. microcephalum *Karst.*
Clitocybe media *Pk.*
C. gallinacea *Scop.*
C. tumulosa *Kalchb.*
C. angustissima *Lasch.*
C. subditopoda *Pk.*
Collybia butyracea *Bull.*
C. acervata *Fr.*
C. ignobilis *Karst.*
Omphalia striæpileus *Fr.*
O. tubæformis *Pk.*
Pleurotus mitis *Pers.*
Hebeloma firmum *Pers.*
Naucoria scirpicola *Pk.*
Galera rufipes *Pk.*
Psathyra silvatica *Pk.*
Cortinarius fulgens *Fr.*
C. lanatipes *Pk.*
C. canescens *Pk.*
C. erraticus *Pk.*
C. cæspitosus *Pk.*
C. lutescens *Pk.*
C. adustus *Pk.*
C. pallidus *Pk.*
Hygrophorus Queletii *Bres.*
H. capreolarius *Kalchb.*
H. hypothejus *Fr.*
H. fuscoalbus *Fr.*
Lactarius atroviridis *Pk.*
L. quietus *Fr.*
Russula purpurina *Q. & S.*
Cantharellus rosellus *Pk.*
Marasmius peronatus *Fr.*
Lenzites heteromorpha *Fr.*
Boletus floccopus *Vahl.*
B. hirtellus *Pk.*
B. subvelutipes *Pk.*
Polyporus piceinus *Pk.*
P. aureo-nitens *Pat.*
P. variiformis *Pk.*
P. rhodellus *Fr.*
P. marginellus *Pk.*
P. sulphurellus *Pk.*
Trametes Pini *Pers.*
Merulius aureus *Fr.*
M. molluscus *Fr.*
Phlebia vaga *Fr.*
P. acerina *Pk.*
Odontia Pruni *Lasch.*
O. fusca *C. & E.*
Thelephora scoparia *Pk.*
Corticium sulphureum *Fr.*
C. rhodellum *Pk.*
C. subincarnatum *Pk.*
Hymenochæte abnormis *Pk.*
Pistillaria viticola *Pk.*
P. alnicola *Pk.*
Mitremyces lutescens *Schw.*
Geaster fornicatus *Fr.*
Phyllosticta Negundinis *S. & S.*
P. serotina *Cke.*
P. Hibisci *Pk.*
Phoma Libertiana *S. & R.*
Diplodia Dulcamaræ *Fckl.*
Hendersonia Mali *Thum.*
Septoria Trichostematis *Pk.*
Sacidium lignarium *Pk.*
Aposphæria aranea *Pk.*
Vermicularia truncata *Schw.*
V. Wallrothii *Sacc.*
Dinemasporium hispidulum *Sacc.*
Glœosporium lagenarium *S. & R.*
G. Physalosporæ *Car.*
G. irregulare *Pk.*
Melanconium Tiliæ *Pk.*
M. foliicolum *Pk.*
Ustilago Osmundæ *Pk.*
Synchytrium aureum *Schrœt.*
Peronospora sordida *Berk.*
Monilia effusa *Pk.*

Monilia aurantiaca *Pk. & Sacc.*
Rhopalomyces Cucurbitarum *B. & R.*
Aspergillus fimetarius *Pk.*
Rhinotrichum ramosissimum *B. & C.*
Virgaria hydnicola *Pk.*
Fusicladium fasciculatum *C. & E.*
Septonema breviusculum *B. & C.*
Cercospora Epilobii *Schnd.*
C. Resedæ *Fckl.*
C. rhuina *C. & E.*
Sporocybe cellare *Pk.*
Helicomyces roseus *Lk.*
Tubercularia fungicola *Pk.*
Tuberculina persicina *Sacc.*
Ombrophila albiceps *Pk.*
Peziza scubalonta *C. & G.*
P. hinnulea *B. & Br.*
Calloria acanthostigma *Fr.*
Valsa coronata *Fr.*
Anthostoma turgidum *Nits.*
Anthostomella limitata *Sacc.*
Nummularia repanda *Fr.*
Chætosphæria longipila *Pk.*
Celidium stictarum *Tul.*
Micrococcus prodigiosus *Cohn.*

Not new to the Herbarium.

Aconitum Noveboracense *Gr.*
Brassica oleracea *L.*
Cakile Americana *Nutt.*
Arabis lyrata *L.*
Hibiscus Moscheutos *L.*
Vitis Labrusca *L.*
V. æstivalis *Mx.*
V. cordifolia *Mx.*
Rhamnus catharticus *L.*
Desmodium Marilandicum *Boott.*
Lespedeza Stuvei *Nutt.*
L. retic. v. angustifolia *Max.*
Rubus strigosus *Mx.*
R. Canadensis *L.*
Pyrus arbutifolia *L.*
Cratægus parvifolia *Ait.*
Proserpinaca pectinacea *Lam.*
Epilobium angustifolium *L.*
Œnothera biennis *L.*
Œ. fruticosa *L.*
Ammannia humilis *Mx.*
Discopleura capillacea *DC.*
Sium lineare *Mx.*
Lonicera oblongifolia *Muhl.*
Eupatorium purpureum *L.*
E. album *L.*
E. teucrifolium *Willd.*
Aster spectabilis *Ait.*
A. concolor *L.*
A. dumosus *L.*
Solidaga odora *Ait.*
S. nemoralis *Ait.*
S. humilis *Pursh.*
S. tenuifolia *Pursh.*
Pluchea camphorata *DC.*
Chrysopsis Mariana *Nutt.*
Coreopsis trichosperma *Mx.*
Artemisia Absinthium *L.*
Erechthites hieracifolia *Raf.*
Centaurea nigra *L.*
Gaylussacia frondosa *T. & G.*
Vaccinium Pennsylvanicum *Lam.*
Rhododendron Rhodora *Don.*
Penstemon pubescens *Soland.*
Pycnanthemum lanceolatum *Pursh.*
Stachys hyssopifolia *Mx.*
Cuscuta Gronovii *Willd.*
C. compacta *Juss.*
Asclepias incarnata *L.*
Atriplex patula *L.*
Amaranthus pumilus *Raf.*
Acnida cannabina *L.*
Polygonum Pennsylvanicum *L.*
P. hydropiperoides *Mx.*
P. maritimum *L.*
Euphorbia Ipecacuanhæ *L.*
Betula glandulosa *Mx.*
Sagittaria variabilis *Engelm.*
Trillium grandiflorum *Salisb.*
Lilium superbum *L.*
Juncus tenuis *Willd.*
J. Greenii *O. & T.*
J. Canadensis *Gay.*
Xyris Caroliniana *Walt.*
Cyperus diandrus *Torr.*
Eriophorum gracile *Koch.*
Scleria reticularis *Mx.*
Scirpus maritimus *L.*
S. debilis *Pursh.*
Carex sterilis *Willd.*
C. scoparia *Schk.*
Aristida dichotoma *Mx.*
Spartina juncea *Willd.*
Bouteloua racemosa *Lag.*

Paspalum setaceum *Mx.*
Panicum filiforme *L.*
P. pauciflorum *Ell.*
P. dichotomum *L.*
P. crus-galli *L.*
Equisetum palustre *L.*
E. variegatum *Schleicher.*
Amanita muscaria *L.*
Lepiota metulispora *B. & Br.*
Armillaria mellea *Vahl.*
Tricholoma laterarium *Pk.*
T. leucocephalum *Fr.*
Clitocybe pithyophila *Fr.*
C. candicans *Pers.*
C. anisaria *Pk.*
C. cyathiformis *Fr.*
C. clavipes *Pers.*
Collybia maculata *A. & S.*
C. cirrhata *Schum.*
C. rubescentifolia *Pk.*
Omphalia chrysophylla *Fr.*
Mycena pura *Pers.*
M. atromarginata *Fr.*
Pleurotus lignatilis *Fr.*
Entoloma sarcophyllum *Pk.*
Clitopilus abortivus *B. & C.*
C. Noveboracensis *Pk.*
Pholiota discolor *Pk.*
Inocybe umboninota *Pk.*
Flammula spumosa *Fr.*
F. alnicola *Fr.*
Agaricus campestris *L.*
Stropharia Johnsoniana *Pk.*
Hypholoma appendiculatum *Fr.*
Coprinus radiatus *Fr.*
Hygrophorus pudorinus *Fr.*
H. coccineus *Fr.*
H. chlorophanus *Fr.*
Hygrophorus miniatus *Fr.*
Lactarius affinis *Pk.*
L. vellereus *Fr.*
L. fuliginosus *Fr.*
L. albidus *Pk.*
Cantharellus minor *Pk.*
C. umbonatus *Fr.*
Marasmius anomalus *Pk.*
Lenzites vialis *Pk.*
L. sepiaria *Fr.*
Boletus rubinellus *Pk.*
B. subtomentosus *L.*
B. porosus *Pk.*
B. flavipes *Pk.*
B. Russellii *Frost.*
B. felleus *Bull.*
Polyporus cæruleoporus *Pk.*
P. chioneus *Fr.*
P. spumeus *Fr.*
P. pubescens *Fr.*
P. biformis *Fr.*
P. versicolor *Fr.*
P. conchifer *Schw.*
P. pergamenus *Fr.*
Trametes sepium *Berk.*
Dædalea confragosa *Pers.*
D. unicolor *Fr.*
Hydnum adustum *Schw.*
H. ochraceum *Pers.*
Irpex lacteus *Fr.*
Sistotrema confluens *Pers.*
Stereum complicatum *Fr.*
S. Curtisii *Berk.*
Clavaria pusilla *Pk.*
C. argillacea *Fr.*
C. fragilis *Holmek.*
C. rugosa *Bull.*

(B.)

CONTRIBUTORS AND THEIR CONTRIBUTIONS.

Mary E. Banning, Baltimore, Md.

Geaster triplex *Jungh.*
G. saccatus *Fr.*
Geaster striatus *DC.*
Tulostoma mammosum *Fr.*

Mrs. E. C. Anthony, Gouverneur, N. Y.

Geaster fornicatus *Fr.*
Geaster mammosus *Chev.*

Mrs. E. G. Britton, New York, N. Y.

Rudbeckia hirta *L.*

Thomas G. Gentry, Philadelphia, Pa.

Polyporus Ribis *Fr.*
P. annosus *Fr.*
Hydnum Schiedermayeri *Heufl.*
Sparassis spathulata *Fr.*
S. laminosa *Fr.*
Corticium rhodellum *Pk.*

F. V. Coville, Oxford, N. Y.

Aconitum Noveboracense *Gr.*
Valerianella radiata *Dupr.*
V. Woodsiana v. patellaria *Gr.*
Polemonium cæruleum *L.*
Arceuthobium pusillum *Pk.*
Quercus ilicifolia *Wang.*
Q. prinoides *Willd.*
Orontium aquaticum *L.*
Polygonum articulatum *L.*
P. Hartwrightii *Gr.*
Listera cordata *R. Br.*
Microstylis ophioglossoides *Nutt.*
Sagittaria graminea *Mx.*
Eleocharis quadrangulata *R. Br.*
Equisetum litorale *Kuhl.*
E. variegatum *Schl.*

Prof. A. N. Prentiss, Ithaca, N. Y.

Graphiola Phœnicis *Poit.*

F. W. Anderson, Great Falls, Mont.

Ustilago Montanensis *E. & H.*

J. N. Bishop, M. D., Plainville, Conn.

Peridermium oblongisporium *Fckl.*

W. H. Hailes, M. D., Albany, N. Y.

Agaricus arvensis *Schæff.*

E. C. Howe, M. D., Lansingburgh, N. Y.

Setaria verticillata *Bv.*
S. Germanica *Bv.*
Apera spica-venti *Bv.*
Panicum pauciflorum *Ell.*
Bouteloua racemosa *Lag.*
Eleocharis diandra *Wright.*
Carex sterilis *Willd.*

C. F. Wheeler, Hubbardston, Mich.

Plowrightia morbosa *Sacc.*

Emily F. Paine, Albany, N. Y.

Aster multiflorus *Ait.*

E. S. Goff, Geneva, N. Y.

Helminthosporium carpophilum *Lev*
Stemonitis herbatica *Pk.*

William Herbst, M. D., Trexlertown, Pa.

Cordyceps capitata *Lk.*

Arthur Hollick, New Brighton, N. Y.

Quercus heterophylla *Mx.*
Q. Rudkini *Britton.*
Quercus Phellos *L.*

C. E. Fairman, M. D., Lyndonville, N. Y.

Corticium rhodellum *Pk.*

Rev. J. L. Zabriskie, Flatbush, N. Y.

Sacidium lignarium *Pk.*
Aposphæria aranea *Pk.*
Sporocybe cellare *Pk.*
Chætosphæria longipila *Pk.*

Hon. W. L. Learned, Albany, N. Y.

Marsilia quadrifolia *L.*

Prof. William Trelease, St. Louis, Mo.

Lycoperdon Missouriense *Trel.*
L. saccatum *Fr.*
Tulostoma fimbriatum *Fr.*

Prof. A. S. Hitchcock, Iowa City, Ia.

Synchytrium Anemones *Wor.*
S. decipiens *Farl.*
Peronospora effusa *Rabh.*
P. Ficariæ *Tul.*
P. gangliformis *DeBy.*
P. Arthuri *Farl.*
P. Euphorbiæ *Fckl.*
P. Lophanthi *Farl.*
P. parasitica *DeBy.*
P. Potentillæ *DeBy.*
P. Halstedii *Farl.*
P. Geranii *Pk.*
P. graminicola *Sacc.*
P. Trifoliorum *DeBy.*
P. pygmæa *Ung.*
P. viticola *DeBy.*
Cystopus candidus *Lev.*
C. Portulacæ *Lev.*
C. Bliti *DeBy.*
Podosphæria tridactyla *DeBy.*
Sphærotheca pannosa *Lev.*
S. Castagnei *Lev.*
Microsphæria extensa *C. & P.*
M. diffusa *C. & P.*
M. Ampelopsidis *Pk.*
M. Russellii *Clint.*
M. Symphoricarpi *Howe.*
M. Friesii *Lev.*
Erysiphe lamprocarpa *Lev.*
E. tortilis *Fr.*
E. Martii *Lev.*
Uncinula adunca *Lev.*
Darluca filum *Cast.*
Peziza Dehnii *Rabh.*
Phyllactinia suffulta *Sacc.*
Phyllachora graminis *Fckl.*
P. Trifolii *Fckl.*
Claviceps purpurea *Tul.*

J. M. Holsinger, Winona, Minn.

Anemone Virginiana *L.*
Ranunculus rhomboideus *Goldie.*
Delphinium azuréum *Mx.*
Isopyrum biternatum *T. & G.*
Berberis repens *Lindl.*
Cardamine rhomboidea *DC.*
Silene nivea *DC.*
Malvastrum coccineum *Gr.*
Ceanothus ovalis *Bigel.*
Amorpha canescens *Nutt.*
Baptisia leucophæa *Nutt.*
B. leucantha *T. & G.*
Glycyrrhiza lepidota *Pursh.*
Lathyrus venosus *Muhl.*
Oxytropus Lamberti *Pursh.*
Petalostemon candidus *Mx.*
P. violaceus *Mx.*
Psoralea argophylla *Pursh.*
Heuchera hispida *Pursh.*
Œnothera serrulata *Nutt.*
Eryngium yuccæfolium *Mx.*
Symphoricarpus occidentalis *R. Br.*
Galium concinnum *T. & G.*
Valeriana edulis *Nutt.*
Vernonia fasciculata *Mx.*
Liatris pycnostachya *Mx.*
Kuhnia eupatorioides *L.*
Solidago speciosa *Nutt.*
Aster azureus *Ait.*
Boltonia asteroides *L'Her.*
Coreopsis palmata *Nutt.*
Silphium perfoliatum *L.*
S. laciniatum *L.*
Bidens connata *Muhl.*
Artemisia caudata *Mx.*
A. Ludoviciana *Nutt.*
A. frigida *Willd.*
A. dracunculoides *Pursh.*
Dodecatheon Meadia *L.*
Acerates longifolia *Ell.*
Gentiana alba *Muhl.*
G. Andrewsii *Griseb.*
Phlox maculata *L.*
Ellisia Nyctelea *L.*
Lithospermum angustifolium *Mx.*
Cuscuta glomerata *Chois.*

Lycium vulgare *Dunal.*
Castilleia sessilifolia *Pursh.*
Penstemon gracilis *Nutt.*
P. grandiflorus *Nutt.*
Verbena bracteosa *Mx.*
V. stricta *Vent.*
Hedeoma hispida *Pursh.*
Monarda punctata *L.*
Plantago Patagonica *Jacq.*
Chenopodium glaucum *L.*
Polygonum ramosissimum *Mx.*
Euphorbia marginata *Pursh.*
Parietaria Pennsylvanica *Muhl.*
Cypripedium candidum *Muhl.*
Liparis Lœselii *Richard.*
Leucocrinum montanum *Nutt.*
Streptopus roseus *Mx.*
Vilfa cuspidata *Torr.*

(C.)

SPECIES NOT BEFORE REPORTED.

Aconitum Noveboracense, *Gr.*

Banks of Chenango river, Oxford, Chenango county. July. *F. V. Coville.* The plant doubtfully referred to *A. Napellus,* Twenty-seventh Report, p. 89, belongs to this species, but in it as well as in the Chenango specimen, the racemes are somewhat hairy, contrary to the requirements of the description of the species.

Hieracium præaltum, *Vill.*

Light sandy soil, near Harrisville, Lewis county. Also, along the road between Great Bend and Le Rayville, Jefferson county. July. This is an introduced species, but it is apparently well established in the localities mentioned. In the Synoptical Flora of North America it is said to grow near Carthage and Evans Mills, but I failed to find it in these localities. It is said in *Science* to have spread extensively in St. Lawrence county, where, in one place, it had taken complete possession of a thirty-acre field and had received the local name "king devil," in allusion to its character as a noxious weed.

Lactuca integrifolia, *Bigel.*

Cornwall, Orange county. This plant occurs in many parts of the State, but it has been considered a variety of *Lactuca Canadensis,* and as such has been recorded. But in the Synoptical Flora it has been raised to specific rank and it is now recorded as a species.

Penstemon lævigatus, *Soland.*

Near the canal, two miles west of Rome. June. Probably introduced from the west.

Lycopus sessilifolius, *Gr.*

Riverhead, Long Island. Formerly regarded as a variety of *L. Europæus,* but now raised to specific rank.

Physalis Peruviana, *L.*

Manor, Long Island. August. Spontaneous in gardens.

Quercus heterophylla, *Mx.*

Tottenville, Staten Island. *A. Hollick.*

Quercus Rudkini, *Britton.*

With the preceding. *Hollick.* The observations of Mr. Hollick upon these two oaks and their environment on Staten Island lead him to the conclusion that they are probably hybrid forms.

Sparganium affine, *Schn.*

Adirondack mountains, North Elba, Lake Sanford, etc. In the Manual this stands as a variety of *S. simplex*, but it is probably a good species. The dwarf terrestrial form was found at Edmonds Ponds and referred to *S. simplex* as a variety in the Thirty-fourth Report, p. 55.

Setaria verticillata, *Bv.*

Along the railroad near Lansingburgh. *E. C. Howe.* Introduced from Europe and very rare in this State.

Apera spica-venti, *Bv.*

Lansingburgh. *Howe.* This is *Agrostis spica-venti* L. It also has been introduced from Europe and is not common.

Equisetum litorale, *Kuhl.*

Oneida lake, near the mouth of Fish creek. *Coville.*

Lepiota augustana, *Britz.*

Groves or borders of woods. Meadowdale, Albany county. July. This scarcely differs from *L. cristata* except in the shape of the spores, and it has generally been referred to that species.

Tricholoma imbricatum, *Fr.*

In groves of spruce and balsam trees, *Abies nigra* and *Abies balsamea.* North Elba, Essex county. Sept. Edible.

Tricholoma subacutum, *n. sp.*

[Plate 1. Figs. 1-5].

Pileus at first ovate or broadly conical, then convex and subacutely umbonate, dry, silky and obscurely virgate with minute innate fibrils, whitish tinged with smoky-brown or bluish-gray, darker on the umbo, flesh white, taste acrid or peppery; lamellæ rather close, slightly

adnexed, white ; stem equal, stuffed or hollow, silky-fibrillose, white; spores broadly elliptical or subglobose, .00025 to .0003 in. long, .0002 to .00025 broad.

Pileus 1.5 to 3 in. broad ; stem 2 to 4 in. long, 3–6 lines thick.

Woods and groves. North Elba. Sept.

The species is perhaps too closely related to *T. virgatum*, but it is separable by its prominent subacute umbo, paler pileus, hollow stem and hot or peppery taste. The cuticle is separable from the pileus.

Tricholoma silvaticum, *n. sp.*

[Plate 2. Figs. 16-19.]

Pileus convex or nearly plane, dry, glabrous, subumbonate, whitish; lamellæ broad, ventricose, subdistant, adnexed, white ; stem subequal, solid, white ; spores rather large, elliptical, .00045 to .0005 in. long, .0003 broad.

Pileus 1 to 1.5 in. broad ; stem 1 to 2 in. long, 2 to 4 lines thick. Mossy ground in woods. North Elba. Sept. The whole plant is white and is related to *T. leucocephalum*, from which it is separated by its subdistant lamellæ, somewhat umbonate pileus and by the absence of any farinaceous odor. From *T. inamœnum* it is distinguished by the absence of odor and stem not radicated.

Tricholoma nobile, *n. sp.*

Pileus fleshy, convex or nearly plane, dry, minutely punctate or squamulose with innate fibrils, whitish or slightly tinged with yellow, flesh white, taste unpleasant, lamellæ broad, rather close, rounded behind and slightly adnexed, white, slowly changing to pale-yellow where wounded; stem equal, solid, slightly floccose-pruinose, whitish; spores minute, subglobose, .00016 to .0002 in. broad.

Pileus 2 to 4 in. broad; stem 1.5 to 2.5 in. long. 4 to 8 lines thick.

Woods. North Elba. Sept.

The plant is closely related to *T. album*, for which it might easily be mistaken, but its habit is more clearly that of other species of Tricholoma, and it may be distinguished by the minute though rather obscure squamules, the insertion of the lamellæ and the subglobose spores. Its taste is very unpleasant and leaves a burning sensation in the mouth and throat for a long time.

Tricholoma brevipes, *Bull.*

Menands, Albany county. Oct. A small form but apparently not distinct.

Tricholoma microcephalum, *Karst.*

Grassy ground in meadows and pastures. North Elba. Sept.

The specimens have the colors of *T. melaleucum*, but the spores agree better with those of *T. microcephalum*. The fresh plant bears some resemblance to small dark colored forms of *Collybia radicata* or to small *C. fuliginella*. The lamellæ retain their white color in the dried state.

Clitocybe media, *n. sp.*

[Plate 1. Figs. 9-12.]

Pileus fleshy, convex, becoming plane or slightly depressed, dry, dark grayish-brown, the margin often wavy or irregular, flesh white, taste mild; lamellæ broad, subdistant, adnate or decurrent, whitish, the interspaces somewhat venose; stem equal or but slightly thickened at the base, solid, elastic, not polished, colored like or a little paler than the pileus; spores elliptical, .0003 in. long, .0002 broad.

Pileus 2 to 4 in. broad; stem 1 to 2 in. long, 4 to 8 lines thick.

Mossy ground in deep woods. North Elba. Sept.

This species is intermediate between *C. nebularis* and *C. clavipes*. In its general appearance, and in the character of the pileus and stem, it resembles *C. nubularis*, but in the character of the more distant lamellæ and in the size of the spores it is nearer *C. clavipes*, of which it might perhaps be regarded as a variety. Two forms are distinguishable. In one the lamellæ are more distant, slightly rounded behind, and adnate or abruptly terminated, in the other they are closer and more distinctly decurrent. The plant is edible. *C. clavipes* is said to be inedible on account of its spongy substance.

Clitocybe gallinacea, *Scop.*

Woods. North Elba. Sept. Both the stem and the pileus appear as if pruinose or slightly mealy. The taste is bitter and unpleasant.

Clitocybe tumulosa, *Kalchb.*

Groves of spruce and balsam. North Elba. Sept. Densely cæspitose. Edible.

Clitocybe angustissima, *Lasch.*

Low wet ground in woods. North Elba. Sept.

Clitocybe subditopoda, *n. sp.*

Pileus thin, convex or nearly plane, umbilicate, hygrophanous, grayish-brown and striate on the margin when moist, paler when dry, flesh concolorous, odor and taste farinaceous; lamellæ broad, close, adnate, whitish or pale cinereous; stem equal, glabrous, hollow, colored

like the pileus; spores elliptical, .0002 to .00025 in. long, .00012 to .00016 broad.

Pileus 6 to 12 lines broad; stem 1 to 2 in. long, about 1 line thick.

Mossy ground in woods. North Elba. Sept.

I have separated this form *C. dilopoda* because of the striate margin of the pileus, paler lamellæ and longer elliptical spores.

Collybia butyracea, *Bull.*

Common in groves of spruce and balsam trees. North Elba. Sept.

Collybia acervata, *Fr.*

Woods. North Elba. Sept. *C. simillima* Pk. is doubtless a mere form of this species. *C. spinulifer* Pk. differs in the spinules of the lamellæ.

Collybia ignobilis, *Karst.*

Mossy ground in balsam groves. North Elba. Sept.

Omphalia striæpileus, *Fr.*

Groves of spruce and balsam. North Elba. Sept.

The specimens differ from the description of the species only in color. They are dingy whitish when moist, white when dry.

Omphalia tubæformis, *n. sp.*

Pileus submembranous, glabrous, deeply umbilicate, grayish, the margin decurved or spreading, lamellæ distant, deeply decurrent, white, sometimes branched, with venose interspaces; stem short, equal or tapering downward, hollow, subpruinose, blackish-brown toward the base; spores elliptical, .0002 in. long.

Pileus 8 to 12 lines broad; stem 6 to 10 lines long.

Dead bark of willow. Menands. June.

Pleurotus mitis, *Pers.*

Prostrate trunks of balsam, *Abies balsamea.* North Elba. Sept.

Hebeloma firmum, *Pers.*

Woods. North Elba. Sept.

Naucoria scirpicola, *n. sp.*

[Plate 2. Figs. 6-10.]

Pileus membranous, at first hemispherical and tomentose, then convex or nearly plane, glabrous or adorned with a few floccose, superficial scales, widely striate on the margin, tawny or subochraceous, subatomate when dry; lamellæ subdistant, slightly adnexed,

colored nearly like the pileus; stem slender flocculose toward the base, white, attached to the matrix by white tomentose filaments; spores elliptical, .0004 to .0005 in. long, .0003 broad.

Pileus 6 to 10 lines broad; stem 8 to 12 lines long, .5 lines thick.

Base of stems of *Scirpus validus*. Patchogue. Aug.

Easily known by the striate margin and the white tomentum of the young pileus. It belongs to the first section of the tribe Lepidoti in the Friesian arrangement.

Galera rufipes, *n. sp.*

[Plate 2. Figs. 11-15.]

Pileus campanulate or convex, hygrophanous, reddish-tawny and striatulate when moist, whitened on the margin by the remains of the white fibrillose veil, pale ochraceous when dry; lamellæ broad, subdistant, emarginate, yellowish or subochraceous, slightly crenulate on the whitish edge; stem slender, hollow, slightly fibrillose below, pruinose at the apex, reddish-brown; spores subochraceous, .00025 to .0003 in. long, .00016 to .0002 broad.

Pileus 4 to 6 lines broad; stem about 1 in. long, .5 line thick.

Mossy ground in woods. North Elba. Sept.

Psathyra silvatica, *n. sp.*

Pileus membranous, campanulate, glabrous, viscid, hygrophanous, dark-brown and striatulate when moist, grayish-brown when dry; lamellæ broad, ascending, subdistant, ferruginous-brown with a white edge; stem slender, subflexuous, hollow, brown; spores brown, .0004 in. long, .00025 broad.

Pileus 4 to 5 lines broad; stem 1 to 2 in. long, .5 line thick.

Mossy ground in woods. North Elba. Sept.

Cortinarius fulgens, *Fr.*

Mixed woods. North Elba. Sept.

This is a showy fungus. The specimens were wholly yellow except the center of the pileus, which was marked with ferruginous or tawny stains and spots.

Cortinarius (Phlegmacium) lanatipes, *n. sp.*

Pileus fleshy, broadly convex or nearly plane, viscose, grayish, often tinged with yellow, becoming yellowish or subfulvous and virgate with innate tawny fibrils when old, flesh whitish; lamellæ narrow, close, adnexed, pale violaceous when young; stem equal or tapering upward, solid, bulbous, subannulate, loosely fibrillose tomentose below, silky

above the annulus, white, veil white; spores elliptical, .0003 in. long, .0002 broad.

Pileus 1 to 3 in. broad ; stem 1 to 2 in. long, 3 to 5 lines thick.

Groves of spruce. North Elba. Sept.

The pale pileus becoming virgate and more highly colored with age and the loose, woolly covering of the stem are the distinguishing features of this species. The bulb is distinct, but scarcely marginate.

Cortinarius (Inoloma) canescens, *n. sp.*

Pileus fleshy, subcampanulate or convex, obtuse or somewhat umbonate, silky or squamulose with innate grayish fibrils, whitish-gray when young, tinged with yellow or rufous hues when old; lamellæ thin, subdistant, rounded behind and adnexed, pallid when young, stem equal or tapering upward from a large, soft, spongy clavate-thickened base, solid, white, peronate and subannulate by the silky-fibrillose white veil, spores elliptical, uninucleate, .0004 to .0005 in. long, .00025 to .0003 broad.

Pileus 2 to 3 in. broad ; stem 2 to 4 in. long, 4 to 6 lines thick.

Abundant and gregarious in groves of spruce. North Elba. Sept.

The species is distinct from its allies by the absence of violaceous hues on the young lamellæ and by its large, spongy bulbous base of the stem. There is no marked odor, but the taste is unpleasant.

Cortinarius (Inoloma) erraticus, *n. sp.*

Pileus fleshy, firm, subcampanulate or convex, obtuse, dry, silky or obscurely squamose with innate fibrils, canescent, often becoming grayish-tawny, flesh dingy-white ; lamellæ subdistant, adnexed, pale-tawny, becoming darker with age ; stem firm, solid, thickened toward the base, white and tomentose below, violaceous above; veil violaceous, often forming an imperfect annulus and sometimes remaining in fragments or floccose scales on the margin of the pileus ; spores elliptical, uninucleate, .0003 in. long, .0002 broad.

Pileus 2 to 3 in. broad ; stem 2.5 to 4 in. long, 3 to 6 lines thick.

Groves of balsam. North Elba. Sept.

This species resembles the preceding one, but is at once distinguished from it by the violaceous color of the veil and the smaller spores.

Cortinarius (Inoloma) cæspitosus, *n. sp.*

Pileus fleshy, firm, convex, often irregular from its crowded mode of growth, silky-fibrillose on the margin, pale-yellow or buff color, often a little darker on the disk, flesh white; lamellæ thin, close, rounded behind and adnexed, whitish when young, then subochra-

ceous; stem nearly equal, solid, subbulbous, cæspitose, silky-fibrillose, subannulate, floccose-villose at the apex, white, spores, elliptical, .0003 to .0004 in. long, .00016 to .0002 broad.

Pileus 2 to 4 in. broad; stem 1 to 3 in. long, 4 to 6 lines thick.

Mossy ground in open places. Catskill mountains. Sept.

The cæspitose mode of growth, yellowish pileus, pale lamellæ and white flesh and stem distinguish this species.

Cortinarius (Dermocybe) lutescens, *n. sp.*

Pileus broadly convex or nearly plane, unpolished, innately fibrillose, squamulose on the disk, dingy-yellow, often with a greenish tint and sometimes marked with reddish or brownish spots, flesh whitish; lamellæ rather broad, close, adnexed, subconcolorous when young, tawny-cinnamon when old; stem equal, firm, silky fibrillose, subannulate from the remains of the veil, colored like the pileus; spores broadly elliptical or subglobose, .00025 to .0003 in. long, .0002 to .00025 broad.

Pileus 1 to 3 in. broad, stem 1 to 1.5 in. long, 2 to 3 lines thick.

Mossy ground in woods. North Elba. Sept.

The pileus is somewhat moist in wet weather which makes the species ambiguous between Dermocybe and Telamonia. The fibrils of the pileus indicate a Dermocybe.

Cortinarius (Telamonia) adustus, *n. sp.*

Pileus broadly campanulate or convex, obtuse, hygrophanous, bay-brown when moist, sometimes canescent on the margin, paler when dry, but smoky-brown with age and generally rimose-squamose, flesh yellowish-gray; lamellæ rather thick, distant, subfree, purplish-brown; stem equal, stuffed or hollow, fibrillose, brownish with a white mycelioid coating at the base, colored within like the flesh of the pileus; spores elliptical, .0003 to .0004 in. long, .0002 to .00025 in. broad.

Pileus 10 to 18 lines broad; stem 1 to 3 in. long, 3 to 5 lines thick.

Balsam groves. North Elba. Sept.

The plant is sometimes cæspitose. The pileus, when old, becomes smoky-brown or blackish and is often chinky or rimose-areolate.

Cortinarius (Hydrocybe) pallidus, *n. sp.*

Pileus thin, broadly convex or nearly plane, glabrous, hygrophanous, pale alutaceous when moist, buff-yellow when dry, flesh concolorous when moist, whitish when dry; lamellæ thin, rather close, ventricose, pallid; stem equal, rigid, hollow, silky-fibrillose, pallid, becoming brownish toward the base; spores subelliptical, .0003 to .00035 in. long, .0002 to .00025 broad.

Pileus 1 to 1.5 in. broad; stem 1.5 to 3 in. long, 1 to 2 lines thick.
Mossy ground in wooded swamps. North Elba. Sept.

Hygrophorus Queletii, *Bres.*

Groves of larch, balsam and spruce. North Elba. Sept.

This species was very abundant in the locality mentioned. It is commonly gregarious and sometimes cæspitose. The viscid pellicle is separable, by which character it is clearly distinct from the allied *H. pudorinus*. When cæspitose the stem and pileus are often irregular. It is a fine species, nearly white, but with the pileus most delicately tinted with pale flesh color.

Hygrophorus capreolarius, *Kalchb.*

Mossy ground in woods. North Elba. Sept.

Although this fungus was regarded by Kalchbrenner as a variety of *H. erubescens*, it appears to me to be a good and distinct species. Many specimens were found in the woods of North Elba but they were constant in their characters. The colors are darker than in *H. erubescens*, and the stem, in the American plant at least, is destitute of red dots or points at the top. No specimens of the true *H. erubescens* were found, although in Hungary the two plants grow in the same places.

Hygrophorus hypothejus, *Fr.*

Woods. North Elba. Sept.

Hygrophorus fuscoalbus, *Fr.*

Groves of spruce and balsam. North Elba. Sept. Our specimens are smaller than the European plant, but in other respects they appear to be the same.

Lactarius atroviridis, *n. sp.*

Pileus fleshy, firm, centrally depressed, scabrous-hairy, sometimes rimose-areolate, dark-green, flesh whitish, milk white, taste acrid; lamellæ rather close, adnate or decurrent, whitish, sometimes spotted, or green on the edge; stem equal, short, hollow, colored like, but often paler than the pileus, spotted; spores yellowish-white, subglobose, rough, .0003 in. in diameter.

Pileus 2.5 to 4 in. broad; stem 1 to 2 in. long, 6 to 10 lines thick.

Borders of woods. Sandlake. Aug.

The color of the pileus is a dark olive green, by which and by its dryness the species may be distinguished from *L. sordidus*. The same species occurs in North Carolina, where it was collected by Rev. C. J. Curtis.

Lactarius quietus, *Fr.*

Low woods. North Elba. Sept.

Russula purpurina, *Q. & S.*

Mossy ground in woods of balsam. North Elba, near Lake Placid. This is a beautiful and very distinct species, easily known by its red stem, mild taste and white spores.

Cantharellus rosellus, *n. sp.*

[Plate 1. Figs. 6–8.]

Pileus thin, infundibuliform, regular, glabrous, pale pinkish-red, flesh white; lamellæ narrow, close, dichotomous, deeply decurrent, whitish, tinged with pink; stem equal, slender, solid, subglabrous, often flexuous, colored like the pileus; spores minute, broadly elliptical, .00014 in. long, .0001 broad.

Pileus 4 to 8 lines broad; stem about 1 in. long, scarcely 1 line thick. Mossy ground in groves of balsam. North Elba. Sept. This small species belongs to the section Agaricoides, and is apparently closely allied to *C. albidus*, from which its smaller size and different color distinguish it. The pileus is sometimes deeply umbilicate

Marasmius peronatus. *Fr.*

Thin woods. North Elba. Sept.

Lenzites heteromorpha, *Fr.*

Stumps of spruce. North Elba. Sept.

In the Thirtieth Report I expressed the opinion that *Lenzites Cookei*, *Dædalea confragosa*, *Trametes rubescens*, etc., were all forms of one species. In Icones Selectæ Hymenomycetum Professor Fries says that *L. heteromorpha* exhibits three forms, one of which belongs to Lenzites, another to Dædalea and another to Trametes, thus showing too great an affinity between these genera. The form here noted belongs to Dædalea. The lenzitoid form, which is taken as the type of the species, was not detected by me.

Boletus floccopus, *Vahl.*

Woods. Selkirk, Albany county. Aug.

The forms which I have referred to this species scarcely differ from *B. strobilaceus*, except in having the tubes depressed around the stem.

Boletus hirtellus, *Pk. ms.*

Sandy soil under pine trees. Rensselaer lake, Albany county. Oct.

Boletus subvelutipes, *Pk. ms.*

Woods. Caroga and Catskill mountains. July.

Polyporus piceinus, *n. sp.*

Pileus 1 to 2 inches broad, thin subcorky, sessile, often concrescent and imbricated, sometimes resupinate or effuso-reflexed, tomentose, concentrically sulcate and adorned with intervening elevated tomentose lines or narrow zones, tawny-brown or subspadiceous, the thin margin at first golden-yellow, soon tawny, then concolorous; hymenium plane or concave, tawny-cinnamon, the pores minute, subrotund, long, the dissepiments thin, but entire; spores minute, subglobose, .00016 in. broad.

Dead trunks and bark of spruce, *Picea nigra.* Sandlake and Adirondack mountains. July to October.

This is a common species in regions where the spruce abounds, yet it does not appear to have been described, nor does it appear to grow on the trunk or bark of any other tree. The pileus often grows as if attached by the vertex, and thus resembles in form the pileus of *Hymenochaete rubiginosa,* or that of *Trametes mollis.* In color it resembles *Lenzites sepiaria* and *Trametes Pini,* but it is generally a little paler or more tawny. Sometimes the fungus appears to revive the second year, and the pores are then obscurely stratose. This, with the peculiar elevated lines of tomentum on the pileus, suggests a resemblance to *Fomes pectinatus,* but our plant would belong rather to the genus Polystictus, if the more recent genera into which the old genus Polyporus has been subdivided should be adopted. In the beginning a minute orbicular tuft of golden velvety hairs or fibres appear. As this tuft enlarges pores are formed in the center just as in *Polyporus* (*Polystictus*) *abietinus,* which sometimes accompanies it. On the under side of prostrate trunks the fungus remains resupinate, or has but a narrow reflexed margin, but in vertical situations a pileus is formed.

Polyporus aureonitens, *Patouillard in lit.*

Pileus 6 to 18 lines broad, rather thick, corky, sessile, variously concrescent and imbricated, minutely velvety-pubescent when young, soon glabrous, radiately fibrous-striate, the young plant and growing margin at first sulphur-yellow, then golden-tawny, finally tawny-ferruginous, generally concentrically marked with darker lines or narrow zones, somewhat shining, substance tawny; pores minute, subrotund, short, ferruginous with a silvery lustre; spores whitish, or very pale yellowish, elliptical-naviculoid, .0002 in. long, .00016 broad.

Trunks of birches, alders and maple, *Acer spicatum*. Sandlake, Catskill and Adirondack mountains. Aug. and Sept.

Related to *P. radiatus*, and like it belonging to the genus Polystictus of modern classification. It is distinguished by its paler color, often lineate-zonate pileus and paler spores.

Polyporus variiformis, *n. sp.*

Pileus 4 to 10 lines broad, coriaceous or subcorky, nearly plane, somewhat strigose-tomentose, tawny-rufescent, subzonate, often nodulose, sometimes wholly resupinate, substance white; pores rather large, subrotund, angular or even flexuous, white, in oblique situations gaping or lacerated.

Var. *nodulosus*. Pilei very small, narrowly reflexed, forming small nodules.

Var. *resupinatus*. Wholly resupinate or with a narrowly reflexed continuous margin.

Var. *interruptus*. Interruptedly resupinate or anastomosingly creeping, marginless.

Prostrate trunks of spruce, *Picea nigra*. Adirondack mountains, North Elba and Cascadeville. June and Sept.

This species is very variable and seems ambiguous between Polystictus, Dædalea and Trametes. It appears to live through the winter and revive again the next season. It is almost corky in texture. The pores are at first pure white, but they become whitish or pallid with age.

Polyporus rhodellus, *Fr.*

Prostrate trunks of hemlock, *Abies Canadensis*. Adirondack mountains. Aug.

This and the two following species belong to the genus Poria of Persoon.

Polyporus marginellus, *n. sp.*

Resupinate, effused, forming extensive patches, 1 to 3 lines thick; subiculum distinct, firm, subcinnamon, the extreme growing margin white, becoming dark-ferruginous with age; pores at first short, sunk in the tomentum of the subiculum, then longer, minute, rotund, often oblique, brownish-ferruginous, glaucous within, the dissepiments thick, obtuse.

Dead bark and decorticated trunks of spruce, *Abies nigra*. North Elba. Sept.

Remarkable for and very distinct by the narrow downy white margin that borders the growing plant.

Polyporus sulphurellus, *n. sp.*

Resupinate, effused, very thin, following the inequalities of the matrix; subiculum and margin downy, white; pores very short, minute, rotund, very pale-yellow, often with a slight salmon tint, the dissepiments obtuse.

Dead bark of poplar. Catskill mountains. Sept.

Trametes Pini, *Fr.*

Railroad ties. Fishkill. Pine trees. Eastport, Long Island. Aug.

Merulius aureus, *Fr.*

Decaying wood of balsam, *Abies balsamea.* North Elba. Sept.

In drying, the specimens become orange colored.

Merulius molluscus, *Fr.*

Bark and decorticated wood of spruce. Averyville, Essex county. Sept.

Phlebia vaga, *Fr.*

Prostrate trunks of acerose trees. North Elba. Sept.

Phlebia acerina, *n. sp.*

Resupinate, effused, irregular, subglabrous beneath, the margin entire; hymenium dingy cream color, becoming darker with age, the folds irregular, obtuse, dentate, subporous.

Wood and bark of maple, *Acer saccharinum.* Mechanicville. July.

Closely related to *P. vaga* from which it appears to be distinct by its entire nearly glabrous margin and less tuberculose or papillate hymenium.

Odontia Pruni, *Lasch.*

Dead bark of wild red cherry, *Prunus Pennsylvanica.* Adirondack mountains. Sept.

Odontia fusca, *C. & E.*

Decaying wood of spruce. Averyville. Sept.

Thelephora scoparia, *n. sp.*

[Plate 2. Figs. 20, 21.]

Incrusting small plants, mosses, etc., here and there emitting fascicles of branches, united below, subterete, acuminate or fimbriately incised, at first pale or whitish, soon ferruginous brown; hymenium even, pruinose-pubescent; spores angular, rough, colored, .0003 to .0004 in. long.

Bethlehem and Selkirk. Aug.

This has the habit and color of *T. laciniata*, but it forms tufts of branches rather than pilei and the hymenium is even. Sometimes it overtops the stems which it incrusts and then it appears stipitate and branched above.

Corticium sulphureum, *Fr.*

Prostrate trunks of balsam. North Elba. Sept.

Corticium rhodellum, *n. sp.*

Thin, membranous, adnate; subiculum and fimbriate margin white or whitish; hymenium slightly pruinose, rosy-incarnate, bearing metuloids .0016 to .002 in. long, .0004 to .00045 broad; spores elliptical, naviculoid, .00016 to .0002 in. long.

Decaying wood. Lyndonville, Orleans county. *C. E. Fairman*, M. D. Specimens have also been found growing on the bark of poplar and communicated to me by *Mr. T. G. Gentry* of Philadelphia.

The species differs from *C. carneum* B. & C. in its brighter color and in the even, not rimose, hymenium. From *C. roseum* Pers. it is distinct by the presence of metuloids and its smaller spores. It belongs to the genus Peniophora of Cooke.

Corticium subincarnatum, *n. sp.*

Effused, thin, pale-yellow, soon subincarnate, even, pruinose-pulverulent, the broad scarcely determinate margin sulphur yellow; spores elliptical, minute, .00016 in. long, .00008 broad.

Decorticated wood of spruce. North Elba. Sept.

Hymenochæte abnormis, *n. sp.*

[Plate 1. Figs. 13–16.]

Pileus effuso-reflexed, coriaceous or subcorky, about six lines broad, generally imbricated and wavy or complicate, tomentose, obscurely zonate, sometimes tuberculate or uneven, blackish; hymenium cinereous, pruinose, setulose with pale-ferruginous blunt setæ; spores oblong, colorless, .0004 to .0005 in. long, .0002 to .00025 broad.

Decaying wood of spruce in wet places. Adirondack mountains. Sept.

Remarkable for the colored but unusually blunt and subcylindrical setæ of the hymenium. These are sometimes paler above and sometimes slightly rough.

Pistillaria viticola, *n. sp.*

[Plate 2. Figs. 25–27.]

Club ovoid or obovoid, obtuse, glabrous, white, about equal to or only half as long as the stem; stem cylindrical or slightly tapering upward, glabrous, .5 to .75 line long, white; spores elliptical, .00025 to .0003 in. long.

Dead stems of grape vine, *Vitis æstivalis*. Ellenville, Ulster county.

Pistillaria alnicola, *n. sp.*

[Plate 2. Figs. 22-24.]

Club ovate or oblong, obtuse, sometimes compressed or irregular, one to two lines high, sessile or with a very short stem-like base, erumpent, glabrous, varying in color from brownish-ochre to bay-red, whitish and spongy within; basidia with four sterigmata; spores ovate, pointed at one end, .0004 to .0006 in. long, .00025 to .0003 broad.

Dead branches of alder, *Alnus incana.* Adirondack mountains. Cascadeville. Sept.

Mitremyces lutescens, *Schw.*

Shaded banks. Ellenville. July. This is considered by Dr. G. Massee to be synonymous with *Calostoma cinnabarina,* Desf.

Geaster fornicatus, *Fr.*

Gouverneur, St. Lawrence county. *Mrs. E. C. Anthony.*

The specimens have numerous rays and belong to var. *multifidus.* Mrs. A. also sends from the same locality a specimen of *G. mammosus,* Chev.

Phyllosticta Negundinis, *Sacc. & Speg.*

Living leaves of box elder, *Negundo aceroides.* Patchogue. Aug.

Phyllosticta serotina, *Cke.*

Living leaves of wild black cherry, *Prunus serotina.* Manor, Long Island. Aug. The wild black cherry is very common in the eastern part of Long Island, and its leaves are often spotted by this fungus. Its branches also are frequently attacked by *Plowrightia morbosa,* the fungus that causes the "black knot," although in the northern and eastern parts of the State this tree is almost entirely exempt from the attacks of this fungus.

Phyllosticta Hibisci, *n. sp.*

Spots suborbicular, whitish or reddish-gray, with a narrow brown border, 2 to 4 lines broad; perithecia minute, .004 in. broad, epiphyllous, black; spores oblong, .0003 to .0004 in. long, .00012 to .00015 broad, usually with one or two nuclei; sporophores simple or branched, .0004 to .0008 in. long.

Living leaves of swamp rose mallow, *Hibiscus moscheutos.* Eastport and Patchogue. Aug.

Phoma Libertiana, *Speg. & Roum.*

Corticated branches of hemlock, *Abies Canadensis.* Sandlake. Aug.

Diplodia Dulcamaræ, *Fckl.*

Dead stems of bittersweet, *Solamun dulcamara.* Sandlake. Aug. The spores are at first simple, and in this condition the fungus might be referred to the genus Sphæropsis.

Hendersonia Mali, *Thum.*

Living leaves of apple tree. Phœnicia, Ulster county. Sept. In our specimens the perithecia are rather smaller than in the type.

Septoria Trichostematis, *n. sp.*

Spots mostly large, but one or two on a leaf, brownish-gray, generally with a broad purplish margin; perithecia epiphyllous, minute, .003 to .004 in. broad, black; spores bacillary, slender, straight or curved, .0012 to .0016 in. long.

Living leaves of blue curls, *Trichostema dichotomum.* Manor. Aug.

Sacidium lignarium, *n. sp.*

Perithecia numerous, scattered or aggregated, thin, membranous, clypeate, astomous, quadrangular or pentangular, black, easily separable from the matrix; spores minute, oblong, colorless or faintly colored, .00016 in. long, .00008 broad.

Bottom of a basswood barrel in a cellar. Flatbush, Long Island. April. *Rev. J. L. Zabriskie.*

Aposphæria aranea, *n. sp.*

Perithecia scattered or gregarious, superficial, astomous, subglobose, submembranous, rupturing irregularly, black, involved in and generally seated on pale webby filaments; spores .00012 to .00016 in. long, about .0001 broad.

With the preceding. *Zabriskie.*

Vermicularia truncata, *Schw.*

Old bean pods. Menands. Oct.

Vermicularia Wallrothii, *Sacc.*

Kind of squash, *Cucurbita melopepo.* Menands. Sept.

Dinemasporium hispidulum, *Sacc.*

Dead wood of *Viburnum dentatum.* West Albany. May.

Glœosporium lagenarium, *Sacc. & Roum.*

Rind of squash, *Cucurbita melopepo.* Menands. Nov.

Glœosporium Physalosporæ, *Car.*

Ripening grapes. Menands. Oct.

Glœosporium irregulare, *n. sp.*

Spots large, irregular, generally but one or two on a leaflet, brown or reddish-brown ; acervuli numerous, hypophyllous, minute ; spores elliptical, obtuse, .0003 to .0004 in. long, .00016 to .0002 broad, oozing out and forming minute subglobose pale or whitish masses.

Living leaves of ash trees, *Fraxinus Americana.* Menands. June.

In the locality mentioned, this fungus has appeared on several trees two years in succession. In some instances nearly all the leaves are affected by it, and in consequence the foliage appears badly blighted and injured as if by fire.

Melanconium Tiliæ, *n. sp.*

Heaps subcutaneous, minute, scarcely elevating the epidermis ; spores ovate or subelliptical, involved in mucus, black, .0009 to .0011 in. long, .0007 to .0008 broad, oozing out and forming small black dot-like stains on the matrix.

Dead branches of basswood, *Tilia Americana.* Mechanicville. July.

This species may be easily recognized by its minute heaps, small spore stains, and by having its spores involved in mucus.

Melanconium foliicolum, *n. sp.*

Spots orbicular, brown or reddish-brown, surrounded by a narrow darker border ; heaps hypophyllous, minute, black ; spores elliptical, slightly colored, .0004 to .0005 in. long, about .0003 broad.

Dead spots on living leaves of sassafras. Manor. Aug.

Ustilago Osmundæ, *Pk.*

Living fronds of royal fern, *Osmunda regalis.* Knox, Albany county. July.

The fungus attacks the apical part of sterile fronds and thickens and distorts the frond tissues. The fresh specimens show that it is scarcely a good Ustilago, inasmuch as the spores appear to be borne at the surface, and not to be deeply seated as in genuine species. Its true affinity is not yet clear. The margin of the affected part of the frond is sometimes whitened by minute fungous filaments. The spores are globose, reddish-brown, slightly rough, .0004 to .0005 in. in diameter. Probably it is an aberrant Uredo.

Synchytrium aureum, *Schrœt.*

Living leaves and petioles of strawberry, *Fragaria Virginiana.* Sandlake. June.

Peronospora sordida, *Berk.*

Living leaves of figwort, *Scrophularia nodosa* v. *Marilandica.* Knowersville, Albany county. July.

Monilia effusa, *n. sp.*

Patches at first small, soon confluent and widely effused, thin, pulverulent, pale tawny or ochraceous; hyphæ hyaline, septate, spores catenulate, limoniform, apiculate at one or both ends, .0006 to .0007 in. long, .0004 to .0005 broad.

Decaying wood. Jayville, St. Lawrence county. July.

From *M. aurea* it differs in its smaller spores and more effused mode of growth.

Monilia aurantiaca, *Peck & Sacc.*

Tufts pulvinate, superficial, rather compact, soon fragile, velvety-pulveraceous, 1 to 6 lines in diameter, sometimes confluent, orange-salmon color; hyphæ radiating, .0004 to .0005 in. broad, irregularly branched, septate as well as the branches, the joints at length separating; spores heteromorphous, at first globose or elliptical, .0004 to .0005 in. broad, or .0007 in. long, .0004 broad, then sublimoniform, forming rather long chains, .0004 to .0005 in. long, .0003 to .00035 broad, the chains often branched.

Dead bark of *Ailanthus glandulosus.* Manor, L. I. Aug.

Related to *M. aureofulva* and *M. sitophila*, but distinct in the color of the tufts and in the form and size of the spores.

Rhopalomyces Cucurbitarum, *B. & R.*

Flowers and fruit of squash. Menands. Aug.

Aspergillus fimetarius, *n. sp.*

White; sterile hyphæ creeping, fertile erect, simple, septate, slightly enlarged at the apex; basidia oblong or subcylindrical, pointed at the apex, .0005 to .0006 in. long; spores globose, .00016 to .0002 in. long.

Excrement of deer. Adirondack mountains. July.

The species is very closely allied to *A. candidus*, but is distinguished by its septate hyphæ, larger spores and different habitat.

Rhinotrichum ramosissimum, *B. & C.*

Decaying oak wood and bark; also on maple wood. Menands and Selkirk. Aug.

Our specimens agree with the description of *R. Curtisii* in the character of the terminal joints of the hyphæ, but in color and spore character they correspond better with the description of *R. ramosissimum.*

Virgaria hydnicola, *n. sp.*

Hyphæ minute, forked or ternately divided, brownish, the ramuli subulate, slightly divergent; spores globose, minute, .0001 to .00015 in. broad.

On a white resupinate Hydnum to which it imparts a smoky brown color. North Elba. Sept.

Fusicladium fasciculatum, *C. & E.*

Living leaves of ipecac spurge, *Euphorbia Ipecacuanha.* Manor. Aug.

Septonema breviusculum, *B. & C.*

Bark of living maple, *Acer saccharinum.* Menands and Knowersville. May and June. This fungus forms a thin black crust over the bark.

Cercospora Epilobii, *Schnd.*

Living leaves of willow herb, *Epilobium angustifolium.* Harrisville and Jayville. July.

Cercospora Resedæ, *Fckl.*

Living or languishing leaves of mignonette, *Reseda odorata.* Menands. Aug. and Sept.

On living leaves the spots are whitish or grayish, but on dead leaves they often become blackish.

Cercospora rhuina, *C. & E.*

Living leaves of dwarf sumac, *Rhus copallina.* Manor. Aug.

Our specimens differ from the type in having the spots blackish and may be designated as variety *nigromaculans.*

Sporocybe cellare, *n. sp.*

Stems .04 to .07 in. long, cylindrical or tapering upward from an enlarged or subbulbous base, straight, blackish-brown, composed of densely compacted filaments except on the surface, capitulum broader than the stem, tawny-brown; spores very numerous, globose, colored, .0002 to .00025 in. broad.

On a barrel in a cellar. Flatbush. March, *Zabriskie.*

It differs from *S. bulbosa Schw.* in the character of the spores.

Helicomyces roseus, *Lk.*

Dead bark of poplar, *Populus tremuloides.* Adirondack mountains. Sept.

Tubercularia fungicola, *n. sp.*

Tubercles minute, scattered, subglobose, .007 to .014 in. broad, orange colored; spores oblong or subfusiform, hyaline, straight or slightly curved, .0004 to .0006 in. long, .00012 broad.

On old *Hypoxylon coccineum.* Knowersville. May.

Tuberculina persicina, *Sacc.*

Parasitic on the Æcidium of *Clematis Virginiana.* Near Lowville, Lewis county. July.

This is apparently a very rare fungus in this State.

Ombrophila albiceps, *n. sp.*

[Plate 2. Figs. 1-5.]

Pileus hemispherical or convex, tough, whitish or sometimes with a faint incarnate tinge, 2 to 4 lines broad; stem equal or slightly thickened at the base, tough, stuffed, appearing as if externally coated with gluten in wet weather, pallid or reddish-brown, 4 to 8 lines long, 1 to 1.5 lines thick; asci narrow, cylindrical, paraphysate, 8-spored, .0016 to .002 in. long, .0002 to .00025 broad; spores minute, elliptical, .0002 in. long, .00012 broad.

Decaying wood of deciduous trees. North Elba. Sept.

This is a very distinct species, easily separated from its allies by its peculiar colors and its external resemblance to species of Leotia. The central pith of the stem is accurately limited and sometimes in drying the stem becomes hollow.

Peziza scubalonta, *C. & G.*

Cow dung. North Elba. Sept. In the dried specimens the hymenium sometimes becomes rimose or perforated by contraction.

Peziza hinnulea, *B. & Br.*

Burnt ground. Menands. Aug.

Calloria acanthostigma, *Fr.*

Decorticated wood of deciduous trees. Adirondack mountains. Aug.

Valsa coronata, *Fr.*

Dead bark of maple, *Acer saccharinum.* Catskill mountains. Sept.

Anthostoma turgidum, *Nits.*

Dead bark of beech, *Fagus ferruginea.* Selkirk. Aug.

Anthostomella limitata, *Sacc.*

Dead stems and branches of swamp honeysuckle, *Lonicera oblongifolia.* Knox. July.

Nummularia repanda, *Fr.*

Dead branches and trunks of mountain ash, *Pyrus Americana.* North Elba. Sept.

Externally this species resembles *N. discreta,* but it may be distinguished by its larger size dentate-lacerated margin of the stroma and ovate spores.

Chætosphæria longipila, *n. sp.*

Perithecia very small, gregarious, black, seated on or involved in a subiculum of very long, slender, webby, cinereous or grayish-brown filaments; asci oblanceolate, the sporiferous part .0016 in. long, .0005 broad; spores crowded or biseriate, straight, .0004 to .0005 in. long, .0002 to .00025 broad, triseptate, the two intermediate cells colored, the terminal ones hyaline.

Old barrel in a cellar. Flatbush. March. *Zabriskie.*

This is related to *C. phæostroma* and *C. phæostromoides*, but it differs from both in its paler subiculum and shorter straight spores.

Celidium stictarum, *Tul.*

Receptacles of lungwort lichen, *Sticta pulmonaria.* Catskill and Adirondack mountains, also in Sandlake. The fungus blackens the surface of the apothecia and thus makes the affected ones easily recognizable.

Micrococcus prodigiosus, *Cohn.*

Stale bread in damp places. Menands. Aug.

(D.)

REMARKS AND OBSERVATIONS.

Proserpinaca pectinacea, *Lam.*

Manor, L. I. Aug. In the State Flora, Vol. 1, p. 241, Dr. Torrey admits this plant on the authority of Dr. Douglas, and says that "it will very probably yet be found on Long Island." It was found, with *Ammannia humilis*, growing on the shores of a pond about half a mile Northwest of Manor. It is a very rare species.

Lonicera oblongifolia, *Hook.*

Tamarack swamp near Knox. Some of the plants in this locality produce united berries, others have them nearly distinct.

Valerianella Woodsiana, *Walp.* var. patellaria, *Gr.*

Alluvial meadows along the Chenango river. Oxford. *Coville.*

Solidago nemoralis, *Ait.*

Elizabethtown, Essex county. A remarkable form with white rays. The general hue of the panicles is creamy yellow.

Rudbeckia hirta, *L.*

This is already a pestilent weed in some parts of the State. In some meadows it has become as plentiful as the white or ox eye daisy. A double flowered form, probably from Marion, Wayne county, was communicated by Mrs. E. G. Britton.

Coreopsis trichosperma, *Mx.* var. tenuiloba, *Gr.*

Near Eastport and Patchogue. Aug. In the Synoptical Flora this variety is attributed to peat bogs in Indiana and Illinois, but either it or a very closely allied form occurs on Long Island. The leaves and their divisions are linear and entire or merely hispidulous-serrulate. The awns of the achenia are variable.

Rhododendron Rhodora, *Don.*

Sam's Point, Ulster county. July. This locality for one of our rare plants was first made known by the late *C. F. Austin.*

Polemonium cæruleum, *L.*

Abundant in alder swamps and bogs in McDonough and Preston, Chenango county. *Coville.*

Celtis occidentalis, *L.*

Banks of Black river near Lowville. This is a form having the leaves variegated with pale greenish yellow angular spots or blotches. The blackberry, *Rubus villosus,* and the red raspberry, *Rubus strigosus,* occasionally occur with variegated foliage.

Arceuthobium pusillum, *Pk.*

Black spruce in Preston, Plymouth and German, Chenango county. *Coville.*

Betula glandulosa, *Mx.*

Abundant in a tamarack swamp between Lake Bonaparte and Harrisville. The shrubs are four to six feet high, and by their size the pale lower surface of the leaves and the longer fertile aments they appear to connect with *B. pumila.* But the branches are somewhat glandular dotted and for this reason the plants are referable to *B. glandulosa.*

Sagittaria graminea, *Mx.*

Abundant about Lake Geneganslet in McDonough. *Coville.*

Epipactis Helleborine, *Crantz, var.* viridens, *Irm.*

This rare orchidaceous plant which was discovered near Syracuse a few years ago and subsequently near Buffalo, has now been detected in a third locality near Otisco, Onondaga county, by *Dr. W. W. Munson.*

Trillium grandiflorum, *Salisb., var.* variegatum, *Pk.*

Additional specimens sent by Mrs. Goodrich show a great variation in the coloring of the flowers. In one specimen two petals had a narrow green dash in the center, the other one was wholly white. In

another specimen the central green line is replaced by a row of green spots. Two specimens have the petals almost wholly green, the extreme apex and adjacent margins only being white. Between these extremes all degrees of variation in the extent of the green coloring exist. The plants grew in abundance, about a hundred specimens having been found. Mrs. G. adds in an accompanying note that two specimens were found in which not only the petals but also the sepals were wholly white.

Eleocharis quadrangulata, *R. Br.*

Lake Neahtowantah, near Fulton, Oswego county. *Coville.*

Paspalum setaceum, *Mx.*

A form was found near Manor, often having two spikes from the upper sheath.

Equisetum variegatum, *Schl.*

Greene, Chenango county, *Coville.* Also near Lerayville, Jefferson county.

Equisetum palustre, *L.*

Banks of the railroad near Lake Bonaparte, Lewis county. Sometimes two or three fertile stems spring from the same root.

Tricholoma transmutans, *Pk.*

Common in spruce and balsam groves in North Elba, where it is associated with *T. imbricatum* and *T. vaccinum*, which it resembles in color, and in its farinaceous odor and taste, but from which it is readily distinguished by its viscid pileus. It belongs to the group of which *T. fulvellum*, *T. flavobrunneum* and *T. albrobrunneum* are representatives, and, though closely allied to these species, it is quite distinct from them. It is an edible species.

Clitopilus Noveboracensis *var.* **brevis**, *n. var.*

Pileus abundantly rivulose, plane or slightly depressed, pallid or subrufescent and pure white on the margin when moist, wholly white or whitish when dry; lamellæ slightly decurrent; stem short, about one inch long.

Groves of spruce and balsam. North Elba. Sept.

This variety manifests a tendency to grow in lines or in arcs of circles. It is often somewhat cæspitose. The white margin of the moist pileus is due to a silky web of interwoven white filaments. This with the short stem and less deeply decurrent lamellæ separate the variety from the typical form.

Polyporus cinnabarinus, *Jacq.*

The usual habitat of this fungus is wood of deciduous trees, but it occasionally occurs on hemlock, *Abies Canadensis.*

Polyporus abietinus, *Fr. var.* irpiciformis *n. var.*

Resupinate, at first orbicular, then often confluent in irregular patches, thin, the margin fimbriate, whitish; hymenium pallid, composed of radiating lamellæ gashed into subulate or fimbriate irpiciform aculei.

Bark of balsam, *Abies balsamea.* North Elba. Sept.

Some fungi belonging to the Polyporei are very variable and break over the generic limits assigned them. The species now under consideration apparently occurs in four well-marked forms, two pileate and two resupinate, one of each belonging to the genus Polyporus, or, as some classify it, to Polystictus, and one of each to Irpex, and therefore to the distinct order Hydnei.

The typical pileate form is very common in the Adirondack forests growing on trunks and branches of spruce, balsam, larch and sometimes on pine and hemlock. A resupinate form is also common. The form known as *Irpex fuscoviolaceus*, which is regarded by some mycologists as belonging to this species, is much more rare and has been observed by me on spruce only. But I have found it growing on the same trunk and in company with *P. abietinus*, and so closely resembling it in all respects save in the hymenium that it is difficult to believe it a distant species. The hymenium is similar in color to that of *P. abietinus*, but it is composed of radiating lamellæ (as in Lenzites), which are incised so as to form teeth or aculei as in Irpex. The discovery of the resupinate variety, now described as var. *irpiciformis*, strengthens the belief in the specific unity of *Irpex fuscoviolaceus* and *Polyporus abietinus*, for here again we have the radiating lamellæ incised into irpiciform teeth, thus showing the structure of the hymenium to be the same as in *I. fuscoviolaceus*, and besides this, we have a variation in color corresponding to that which occurs in the hymenium of *P. abietinus.* For in the resupinate form of *P. abietinus* the color of the hymenium, even in young and growing specimens is often much paler than in the typical pileate form, exhibiting scarcely a trace of violaceous color, but showing rather a pallid hue with a slight suggestion of pale cinnamon. This peculiar color is seen in variety *irpiciformis* and enforces the conclusion that it is not a distinct species of Irpex but rather a mere variety of *P. abietinus.* It indicates a very intimate connection between Lenzites among the Agaricini, Polyporus

among the polyporei and Irpex among the Hydnei. Such a blending of generic characters in one species is not very assuring to our present estimation of generic limits.

Corticium cinereum *Fr. var.* **fumigatum,** *Thum.*

Dead branches of hickory, *Carya alba.* Selkirk. June.

Geoglossum vitellinum, *Bres.*

Very abundant and luxuriant in mossy damp ground in the woods of North Elba. It was tested for its edible quality and found to be good. Its small size would ordinarily make it of but little importance as an esculent fungus, but this objection to it is in great measure obviated when it occurs in great profusion. It maintains the irregular character of the species even when growing luxuriantly.

(E.)

NEW YORK SPECIES OF CLITOPILUS.

Clitopilus, *Fr.*

Stem fleshy or fibrous, diffused above into the pileus, of which the margin is at first involute. Hymenophore continuous with the stem. Lamallæ equally attenuated behind and subdecurrent, neither separating nor sinuate.

Terrestrial, often strong smelling, the pileus more or less depressed or umbilicate, the umbilicus similarly colored.

This genus belongs to the rosy or pink-spored series, and corresponds to Clitocybe in the white-spored series. It is separated from Eccilia by its fleshy stem, and from Entoloma by its adnate or decurrent lamellæ. The species are less numerous than those of Clitocybe, and some are separable from that genus by a slight difference in the color of the spores only. The spores of most of the species have the usual flesh-colored hue of the series Hyporhodii, but in two species they are more highly colored, exhibiting a rosy-red hue, while in a few species they are very pale, barely tinted with flesh color when caught on white paper. If caught on black or brown paper they appear sordid or whitish, and the species might then be sought in the genus Clitocybe. The spores of different species vary also in size and shape, thus furnishing important specific characters. Some of the species are edible, others are bitter and unpleasant in flavor. A farinaceous odor is observable in several species, and this is sometimes accompanied by a bitter taste. Most authors follow Fries in the

arrangement of the species, dividing them into two groups, the Orcelli, distinguished by deeply decurrent lamellæ and an irregular, scarcely hygrophanous pileus, with the margin at first flocculose; and Sericelli, distinguished by adnate or slightly decurrent lamellæ, and a regular silky or hygrophanous-silky pileus with a naked margin. This arrangement is not strictly applicable to some of our species. *C. abortivus*, *C. erythrosporus* and *C. Noveboracensis* have the lamellæ deeply decurrent in some individuals, adnate or slightly decurrent in others, and therefore the same species might be sought in both groups. For this reason, the primary grouping of our species has been made to depend on the variation in the spore colors. By far the greater number of our species appear to be peculiar to this country, only two of them occurring also in Europe.

Synopsis of the Species.

	Spores and mature lamellæ flesh-colored	1
	Spores and mature lamellæ rosy-red	9
	Spores very pale flesh-colored	10
1.	Pileus hygrophanous	8
1.	Pileus not hygrophanous	2
2.	Pileus gray or grayish-brown	5
2.	Pileus some other color	3
3.	Pileus white or whitish	4
3.	Pileus pale tan-color	*C. pascuensis.*
4.	Pileus firm, dry, pruinate	*C. prunulus.*
4.	Pileus soft, slightly viscid when moist	*C. Orcella.*
5.	Pileus large, more than 1.5 in. broad	*C. abortivus.*
5.	Pileus small, less than 1.5 in. broad	6
6.	Spores even	*C. unitinctus.*
6.	Spores angular	7
7.	Stem longer than the width of the zoneless pileus	*C. albogriseus.*
7.	Stem shorter than the width of the commonly zonate pileus	*C. micropus.*
8.	Pileus brown or grayish brown	*C. subvilis.*
8.	Pileus white or yellowish-white	*C. Woodianus.*
9.	Stem colored like the pileus	*C. erythrosporus.*
9.	Stem white, paler than the pileus	*C. conissans.*
10.	Pileus even	11
10.	Pileus rivulose	*C. Noveboracensis.*
11.	Stems cæspitose, solid	*C. cæspitosus.*
11.	Stems not cæspitose, hollow	*C. Seymourianus.*

Spores flesh-colored.

a. Spores even.

Clitopilus prunulus. *Scop.*

Plum Clitopilus.

Pileus fleshy, *compact*, at first convex and regular, then repand, *dry, pruinate*, white or cinereous white, flesh white, unchangeable, with a pleasant farinaceous odor; lamella deeply decurrent, subdistant, flesh-colored; stem solid, naked, striate, white; spores subelliptical, pointed at each end, .0004 to .00045 in. long, .0002 to .00025 broad.

Pileus 1.5 to 3 in. broad, stem 1 to 2 in. long, 3 to 4 lines thick.

Woods. Albany, Rensselaer and Saratoga counties.

Not abundant, but edible and said to be delicious and one of the best of the esculent species.

Clitopilus Orcella, *Bull.*

Pileus fleshy, *soft*, plane or slightly depressed, often irregular, even when young, *slightly silky, somewhat viscid when moist*, white or yellowish-white, flesh white, taste and odor farinaceous; lamellæ deeply decurrent, *close*, whitish, then flesh-colored; stem short, solid, flocculose, often eccentric, thickened above, white; spores elliptical, .00035 to .0004 in. long, .0002 broad.

Generally a little smaller than the preceding species, softer and more irregular, but so closely allied that by some it is considered a mere variety of it. It is said to be edible and of a delicate flavor. It occurs in wet weather in pastures and open places. Rensselaer county.

Clitopilus pascuensis, *Pk.*

Pasture Clitopilus.

Pileus fleshy, compact, centrally depressed, *glabrous, reddish or pale-alutaceous*, the cuticle of the disk cracking into minute areas; lamellæ rather narrow, close, decurrent, whitish, becoming flesh-colored; stem short equal or tapering downward, solid, glabrous, colored like the pileus; spores subellipitical, pale incarnate, .0003 to .0004 in. long, .0002 to .00025 broad.

Pileus 2 to 3 in. broad; stem 8 to 18 lines long, 4 to 6 lines thick.

Pastures. Saratoga county.

The species is related to *C. prunulus* from which it is distinct by its shorter, paler spores, its glabrous pileus rimose-areolate on the disk, and tinged with red or alutaceous and by its paler lamellæ. From *C. pseudo-orcella* it differs in its glabrous pileus with no silky luster

and in its closer lamellæ. Its odor is obsolete but it has a farinaceous flavor. It is probably esculent, but has not been found in sufficient quantity to afford a test of qualities.

Clitopilus unitinctus, *Pk.*

One-colored Clitopilus.

Pileus thin, *submembranous,* flexible, convex or nearly plane, centrally depressed or umbilicate, glabrous, subshining, often concentrically rivulous, grayish or grayish-brown, flesh whitish or grayish-white, odor obsolete, taste mild; lamellæ narrow, moderately close, *adnate or slightly decurrent,* colored like the pileus; stem slender, straight or flexuous, subtenacious, equal, slightly pruinose, grayish-brown, with a close white mycelioid tomentum at the base and white root-like fibres of mycelium penetrating the soil; spores elliptical, .0003 in. long, .0002 broad.

Var. *albidus.* Whitish or grayish-white, not rivulose; lamellæ broader; spores brownish flesh-color.

Pileus 6 to 16 lines broad; stem about 1 in. long, 1 line thick.

Woods of pine or balsam. Albany and Essex counties. Autumn.

The variety is a little paler than the typical form, with lamellæ a little broader, but is probably not specifically distinct. The species is apparently closely related to *C. cicatrisatus* but differs in color. The pileus is somewhat silky-shining and is often wavy on the margin.

b. Spores angular or irregular.

1. *Pileus not hygrophanous.*

Clitopilus abortivus, *B. & C.*

Abortive Clitopilus.

Pileus fleshy, firm, convex or nearly plane, regular or irregular, dry, *clothed with a minute silky tomentum,* becoming smooth with age, gray or grayish-brown, flesh *white,* taste and odor subfarinaceous; lamellæ thin, close, slightly or deeply decurrent, at first whitish or pale-gray, then flesh-colored; stem nearly equal, solid, minutely flocculose, sometimes fibrous-striated, colored like or paler than the pileus; spores irregular, .0003 to .0004 in. long, .00025 broad.

Pileus 2 to 4 in. broad; stem 1.5 to 3 in. long, 3 to 6 lines thick.

Ground and old prostrate trunks of trees in woods and open places. Rensselaer, Lewis and Albany counties. August and September.

This species is, in our State, the most abundant one of the genus. It is commonly gregarious, but it is also scattered and cæspitose. Frequently it fails to develop properly, and then forms irregular or subglobose fleshy whitish masses similar to those sometimes formed

by *Armillaria mellea.* These generally occur in company with the normal form and apparently under the same conditions of soil, moisture and temperature. They are suggestive of the name of the species. Our plant is related to *C. popinalis,* from which it is distinguished by its firmer less glabrous unspotted pileus, paler flesh and larger spores. *C. popinalis* var. *firmatus* is more closely allied by its compact texture, but its spotted pileus and umber-brown color both without and within easily distinguish it. Our species has been found to be edible, but its flavor is scarcely as agreeable as that of some other species.

Clitopilus albogriseus, *Pk.*

Pale-gray Clitopilus.

Pileus firm, convex or slightly depressed, *glabrous,* pale-gray, odor farinaceous; lamellæ moderately close, adnate or slightly decurrent, grayish, then flesh-colored; stem solid, colored like the pileus; spores angular or irregular, .0004 to .0005 in. long, .0003 broad.

Pileus 6 to 12 lines broad; stem 1.5 to 2.5 in. long, 1 to 2 lines thick.

Woods. Adirondack mountains. August.

Clitopilus micropus, *Pk.*

Short-stemmed Clitopilus.

Pileus thin, fragile, convex or centrally depressed, *umbilicate, silky,* gray, usually with one or two narrow zones on the margin, odor farinaceous; lamellæ narrow, close, adnate or slightly decurrent, gray, becoming flesh-colored; stem *short,* solid, slightly thickened at the top, pruinose, gray, with a white mycelium at the base; spores angular or irregular, .0004 in. long, .00025 broad.

Pileus 6 to 12 lines broad; stem 8 to 10 lines long, 1 line thick.

Thin woods. Essex and Rensselaer counties. Aug.

This species is closely allied to the preceding one, but may be separated from it by its short stem and silky umbilicate subzonate pileus. Both species are rare and have been observed only in wet, rainy weather.

2. *Pileus hygrophanous.*

Clitopilus subvilis, *Pk.*

Worthless Clitopilus.

Pileus thin, centrally depressed or umbilicate, with the margin decurved, hygrophanous, *dark-brown* and striatulate on the margin when moist, grayish-brown and silky-shining when dry, taste farinaceous; lamellæ *subdistant,* adnate or slightly decurrent, whitish when young, then flesh-colored; stem slender, brittle, rather long, *stuffed or hollow,*

glabrous, colored like the pileus or a little paler; spores angular, .0003 to .0004 in. long.

Pileus 8 to 15 lines broad, stem 1.5 to 3 in. long, 1 to 2 lines thick.

Damp soil in thin woods. Albany county. October.

The species is allied to *C. vilis*, from which it is separated by its silky-shining pileus subdistant lamellæ and farinaceous taste.

Clitopilus Woodianus, *Pk.*

WOODS CLITOPILUS.

Pileus thin, convex or nearly plane, umbilicate or centrally depressed, hygrophaneous; striatulate, on the margin when moist, *whitish or yellowish-white* and shining when dry, the margin often wavy or flexuous; lamellæ *close*, adnate or slightly decurrent, whitish, then flesh-colored; stem equal, flexuous, shining, *solid*, colored like the pileus; spores subglobose, angular, .00025 to .0003 in. long.

Pileus 1 to 2 in. broad; stem 2 to 3 in. long, 2 lines thick.

Ground and decayed prostrate trunks in woods. Lewis county. September.

This species is perhaps too closely allied to the preceding, but it may easily be separated by its paler color, closer lamellæ and solid stem, though this is sometimes hollow from the erosion of insects. In color it resembles *Entoloma Grayanum*, but it is a much more slender species with a different mode of attachment to the lamellæ.

Spores rosy-red.

Clitopilus erythrosporus; *Pk.*

RED-SPORED CLITOPILUS.

Pileus thin, hemispherical or strongly convex, glabrous or merely pruinose, pinkish-gray, flesh whitish tinged with pink, taste farinaceous, lamellæ narrow, crowded, arcuate, *deeply decurrent*, colored like the pileus; stem equal or slightly tapering upward, hollow, slightly pruinose at the top, *colored like the pileus;* spores elliptical, .0002 in. long, .00012 to .00016 broad.

Pileus 1 to 2 in. broad; stem 1 to 1.5 in. long, 2 to 3 lines thick.

Decayed wood and among fallen leaves in woods. Albany and Ulster counties. September and October.

The species is easily recognized by its peculiar uniform color, its narrow, crowded and generally very decurrent lamellæ and by its bright rosy-red spores. Sometimes individuals occur in which the lamellæ are less decurrent.

Clitopilus conissans, *Pk.*

Dusted Clitopilus.

Pileus thin, convex, glabrous, pale-alutaceous, often *dusted by the copious spores;* lamellæ close, *adnate,* reddish-brown; stem slender, brittle, hollow, cæspitose, *white;* spores narrowly elliptical, .0003 in. long, .00016 broad.

Pilus 1 to 1.5 in. broad; stem 1 to 2 in. long, 1 to 2 lines thick.

Base of an apple tree. Catskill mountains. September.

Remarkable for the copious bright rosy-red spores which are sometimes so thickly dusted over the lower pilei of a tuft as to conceal their real color. The species is very rare.

Spores very pale flesh-colored, merely tinted.

Clitopilus cæspitosus, *Pk.*

Tufted Clitopilus.

Pileus at first convex, firm, nearly regular, shining, white, then nearly plane, fragile, often irregular or eccentric, glabrous but with a slight silky lustre, *even,* whitish, flesh white, *taste mild;* lamellæ narrow, thin, crowded, often forked, adnate or slightly decurrent, whitish, becoming dingy or brownish-pink; stems *cæspitose,* solid, silky-fibrillose, slightly mealy at the top, white; spores .0002 in. long, .00016 broad.

Pileus 2 to 4 in. broad; stem 1.5 to 3 in. long, 2 to 4 lines thick.

Thin woods and pastures. Ulster county. Sept.

This is a large, fine species, very distinct by its cæspitose habit, white color and very pale sordid-tinted spores. But for the color of these the plant might easily be taken for a species of Clitocybe. The tufts sometimes form long rows.

Clitopilus Noveboracensis, *Pk.*

New York Clitopilus.

Pileus thin, convex, then expanded or slightly depressed, dingy white, *rimose-areolate or concentrically rivulose,* sometimes obscurely zonate, odor farinaceous, *taste bitter;* lamellæ narrow, close, deeply decurrent, some of them forked, white, becoming dingy, tinged with yellow or flesh-color; stem equal, solid, colored like the pileus, the mycelium white, often forming white branching root-like fibres; spores globose, .00016 to .0002 in. broad.

Var. *brevis.* Margin of the pileus, in the moist plant, pure white; lamellæ adnate or slightly decurrent; stem short.

Pileus 1 to 2 in. broad; stem 1 to 2 in. long, 1 to 3 lines thick.

Woods and pastures. Adirondack mountains, Albany and Rensselaer counties. August to October.

The plant is gregarious or cæspitose. Sometimes, especially in the variety, it grows in lines or arcs of circles. The margin is often undulated, and in the variety it is, when fresh and moist, clothed with a film of interwoven webby white fibrils which give it a peculiar appearance, and if the spore characters are neglected it might be mistaken for *Clitocybe phyllophila.* The disk is often tinged with reddish-yellow or rusty hues when moist and its rivulose character is then more distinct. A farinaceous odor is generally present, especially in the broken or bruised plant, but its taste is bitter and unpleasant. Sometimes bruises of the fresh plant manifest a tendency to assume a smoky-brown or blackish color. The base of the stem is sometimes clothed with a white mycelioid tomentum. The species is apparently closely allied to *C. concentricus*, Gill., of which the lamellæ are said to be cinereous or reddish-cinereous, and the spores of a dirty rosy hue.

Clitopilus Seymourianus, *Pk.*

Seymour's Clitopilus.

Pileus fleshy, thin, broadly convex or slightly depressed, even, *pruinose, whitish with a dark lilac tinge,* sometimes lobed and eccentric; lamellæ narrow, crowded, decurrent, some of them forked at the base, whitish with a pale flesh-colored tint; stem equal, silky-fibrillose, *hollow;* spores minute, globose or nearly so, .00014 to .00016 in. long.

Pileus 1 to 2.5 in. broad; stem 1.5 to 2.5 in. long, 3 to 4 lines thick.

Woods. Lewis county. September.

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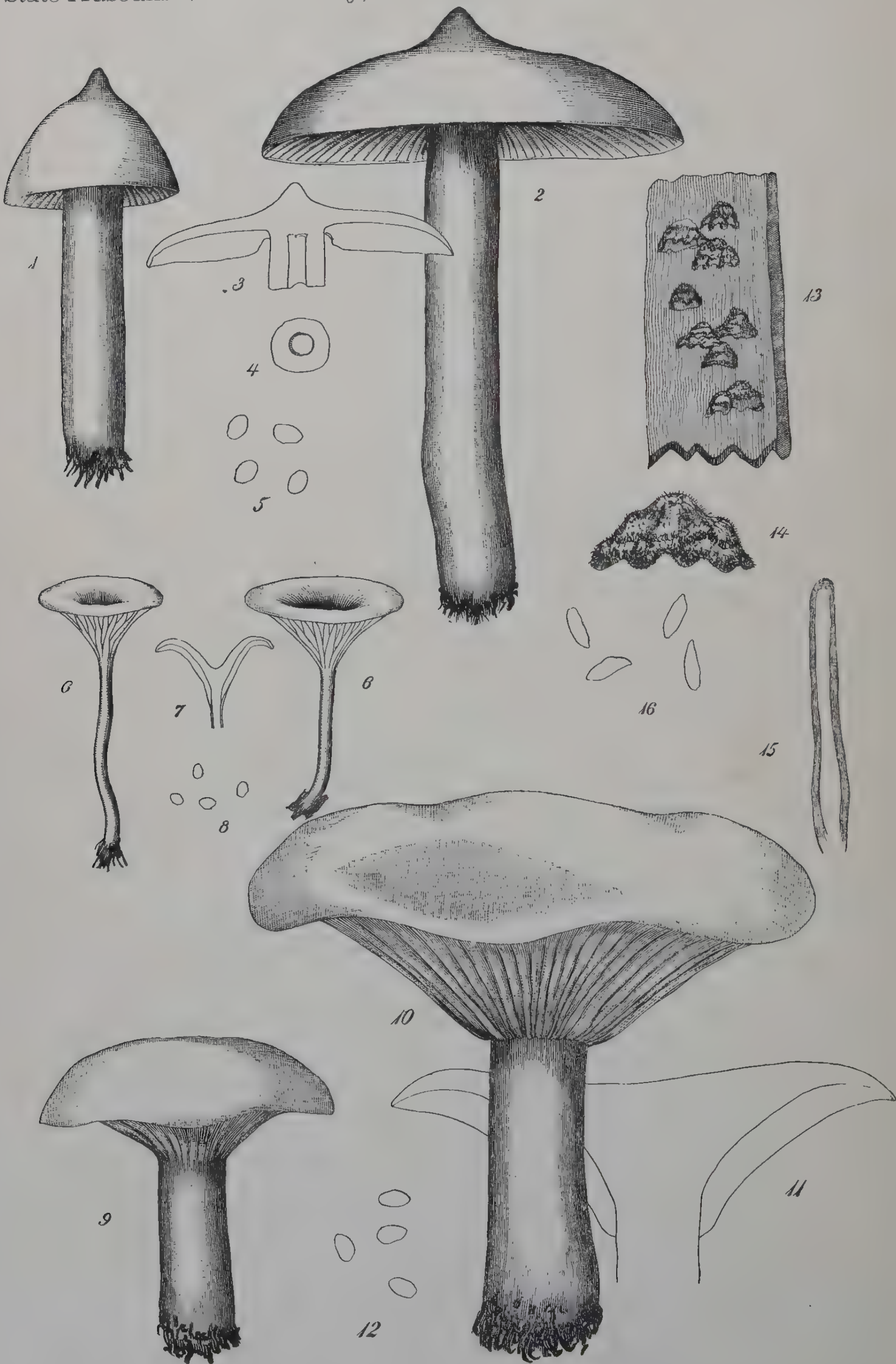

EXPLANATION OF PLATE 1.

Tricholoma subacutum, *Peck.*

Fig. 1. An immature plant.
Fig. 2. A mature plant.
Fig. 3. Vertical section of a pileus and upper part of its stem.
Fig. 4. Transverse section of a stem.
Fig. 5. Four spores x 400.

Cantharellus rosellus, *Peck.*

Fig. 6. Two mature plants.
Fig. 7. Vertical section of a pileus and upper part of its stem.
Fig. 8. Four spores x 400.

Clitocybe media, *Peck.*

Fig. 9. An immature plant.
Fig. 10. A mature plant.
Fig. 11. Vertical section of a pileus and upper part of its stem.
Fig. 12. Four spores x 400.

Hymenochæte abnormis, *Peck.*

Fig. 13. Piece of spruce wood bearing eight plants.
Fig. 14. A plant enlarged.
Fig. 12. A seta from the hymenium x 400.
Fig. 16. Four spores x 400.

EXPLANATION OF PLATE 2.

Ombrophila albiceps, *Peck.*

Fig. 1. Piece of wood bearing four plants.
Fig. 2. A plant enlarged.
Fig. 3. A dried plant enlarged.
Fig. 4. An ascus with its spores and a paraphysis x 400.
Fig. 5. Four spores x 400.

Naucoria scirpicola, *Peck.*

Fig. 6. An immature plant.
Fig. 7. A mature plant.
Fig. 8. Vertical section of a pileus and upper part of its stem.
Fig. 9. Transverse section of a stem.
Fig. 10. Four spores x 400.

Galera rufipes, *Peck.*

Fig. 11. A moist plant.
Fig. 12. A dry plant.
Fig. 13. Vertical section of a pileus and upper part of its stem.
Fig. 14. Transverse section of a stem.
Fig. 15. Four spores x 400.

Tricholoma silvaticum, *Peck.*

Fig. 16. A small umbonate plant.
Fig. 17. A larger plant without an umbo.
Fig. 18. Vertical section of a pileus and upper part of its stem.
Fig. 19. Four spores x 400.

Thelephora scoparia, *Peck.*

Fig. 20. Three plants attached to different matrices.
Fig. 21. Four spores x 400.

Pistillaria alnicola, *Peck.*

Fig. 22. Piece of bark of alder bearing four plants.
Fig. 23. A plant and its matrix enlarged.
Fig. 24. Four spores x 400.

Pistillaria viticola, *Peck.*

Fig. 25. Fragment of grape vine bearing six plants.
Fig. 26. A plant enlarged.
Fig. 27. Four spores x 400.

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REPORT

OF THE

STATE ENTOMOLOGIST

TO THE

Regents of the University, State of New York,

FOR THE YEAR 1888.

CONTENTS.

REPORT.

Office of the State Entomologist,
Albany, *December* 11, 1888.

To the Honorable Board of Regents of the University of the State of New York:

Gentlemen.— In accordance with chapter 355 of the Laws of 1883, I beg leave to present to your honorable board the following report embracing, results of my studies and observations on the Insects of the State of New York during the year 1888:

Interesting insect attacks of an unusual number have presented themselves for study, of which by far the larger number have been upon our fruit crops. While it is evident to all who are engaged in agricultural pursuits that insect depredations are annually increasing in our country, both in the number of pests and in the aggregate of the losses that they occasion, it is equally evident to the entomologist, who is specially charged with the study of these depredations, that the increase in new forms of attack lies largely in the direction of fruit pests. A sufficient reason for this may be found in the increasing attention that is being given to fruit culture, and its remarkable extension, as a commercial interest, year by year. How such extension in the production of special crops tends to augment insect ravages in still greater proportion, has been shown by me in former reports and needs not to be repeated at the present.

Several of the new attacks are still under study and have not progressed sufficiently to warrant present report upon them. Of these are two forms of insect injury to fruits and fruit trees which have for years been an enigma to us, but have found their explanation during the past summer, although not yet assigned to the particular species which cause the injury. In one, the young fruit of the apple and pear, and perhaps the quince, are pitted, become gnarled, often distorted, and fail of development even when they remain upon the tree; in the other, the trunks and

limbs of fruit trees show areas of different sizes, varying from a fraction of an inch to several inches, in which the sapwood is killed so as to disclose patches of the dead inner wood from over which the bark has broken away, leaving deeply depressed dead portions, around the margin of which the annual growth of sapwood following the injury builds up an irregular wall.

An extraordinary multiplication of a common fruit-tree pest, the apple-tree tent-caterpillar, *Clisiocampa Americana*, during the past summer in the State of New York was such a phenomenal event as to draw wide-spread attention to it. There is no record of its ever having appeared before in such enormous numbers over so extended a territory. Apple orchards in the eastern counties of the State, and in portions of New England and New Jersey, were only saved from defoliation through much earnest labor. Where it had not been thought necessary to contend with the caterpillar, as in its occurrence on the wild cherry and other trees upon which it feeds, the leaves were eaten to the last fragment, and the defoliation was as complete as if they had been swept by fire. In passing through the country a prominent feature of the landscape was the multitude of these leafless trees in midsummer, bearing in the forks of their branches the white web nests to the number often of from twenty to forty in a single tree, which the caterpillars had built up for their shelter at night and during rains.

In connection with the above reference to fruit pests, it may be of interest to state that injuries from the same source have been reported in England the present year, to even a greater extent than with us. Miss Ormerod, the eminent entomologist of the Royal Agricultural Society of England has written me: "The orchards in our fruit-growing counties were in some cases devastated by the hordes of Lepidopterous caterpillars of various kinds that swept off the foliage — in some instances even killing the trees." Mr. Charles Whitehead, Agricultural Adviser to the Agricultural Department of England, has recently reported as follows: "In many of the principal fruit-producing districts, caterpillars have lately caused most serious injury to apple, pear, plum, damson, filbert, and other fruit trees, so that in some cases the whole crop has been lost. When the blossom buds and leaf buds began to unfold, it was seen that they were attacked by legions of caterpillars. Soon the blossoms and leaves were entirely devoured, or

so much injured as to be useless. The fruit plantations in parts of Kent, Hereford, Worcester, and some other counties where fruit is extensively grown, looked as if a hot wind had passed over them."

Grain nor grass crops have not suffered to any unusual extent. Injury to June grass (*Poa pratensis*) through a thrips attack, which has been noticed for several years, in which the larva extracts the juices from the upper joint of the grass at its base, causing its speedy withering and drying up, is apparently increasing and largely extending its range. A similar attack on Timothy grass (*Phleum pratense*) has been reported from Canada the present year, and has also been observed by me in Albany county. I have failed in my effort to rear the larvæ to the perfect stage, and thereby verify or disprove my belief that the Timothy insect is identical with that which for a long term of years has been infesting June grass,* to which Professor Comstock some time since gave the MS. name of *Limothrips poaphagus*, and has recently published its characteristic features.

A feature of the year has been a remarkable exemption from aphis injuries. The hop crop was unusually free from aphis presence — in striking contrast with its excessive abundance and destructiveness in 1886. Not a single complaint was received by me of aphis injury to apple trees at the opening of the season when almost annually the insect threatens the destruction of the starting buds and the unfolding leaves. In a few cases only was aphis attack of any kind reported, and then merely to some of the minor garden crops.

In several portions of the State, the Colorado potato-beetle was very abundant, showing that the pest is not disposed to abandon the territory which it has occupied for a number of years, and that it is still necessary to meet it persistently with the arsenical insecticides, which, properly used, are adequate to its control.

There has been a notable increase in the operations of the oak-pruner, *Elaphidion parallelum* Newman., in the southeastern portion of the State, in cutting off the ends of the branches and dropping them to the ground. A number of reports of its injuries — not only to oaks but also to maples — have been received from localities on Long Island. In one instance where the attacked

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* Report of the State Entomologist to the Regents of the University, S. N. Y., for 1886, pp. 96-98.

trees were serving as ornaments of a lawn, it had been necessary to gather the pruned tips and branches from the ground from time to time, and carry them away by the cart-load for burning. From features shown in the excised material sent me, it is thought that more than one species of *Elaphidion* may have been engaged in these attacks. This will be ascertained when the beetles have been reared from the infested twigs.

From several sections of the State, as notably from Jefferson county, unusually severe attacks from the rose-bug, *Macrodactylus subspinosus* (Fabr.), have been reported—in some instances destroying both the foliage and the fruit of the plum, the cherry, and the grape.

Fuller's rose-beetle, *Aramigus Fulleri* Horn, a destructive curculionid beetle, but fortunately of only local distribution, has occasioned considerable trouble in the rose-houses in Rochester, N. Y. Mr. W. J. Palmer states that the beetle is found in the morning sitting at the base of the leaves, and if disturbed, usually escapes by dropping to the ground and hiding.

The white grub, *Lachnosterna fusca* (Frolich), has inflicted much damage on pastures in Lewis county, by eating the roots of the grasses. On one farm, that of Mr. J. L. Seymour, near Lyons Falls Station, it had destroyed thirty acres of pasture, and its operations at the time the report was made, seemed to be spreading to several other farms in the vicinity.

I regret that the very brief time that has elapsed between the printing of my fourth report (issued November twenty-third) and the presentation to your honorable board of the present one, has not permitted the more careful preparation and arrangement of the following pages which they would otherwise have received, and the introduction of some desired original illustration. I would, therefore, beg the indulgence of my fellow entomologists, and of those who may be familiar with most of the figures presented, so long as they will be new and serviceable to many of the agriculturists whom they will reach.

Respectfully submitted.

J. A. LINTNER.

REMEDIES AND PREVENTIVES OF INSECT ATTACKS.

CUTTING OUT THE SQUASH-VINE BORER.

This pernicious insect — the larva of *Melittia cucurbitæ* (Harris) — of the injuries of which complaints are often received, was given an extended notice in the *Second Report on the Insects of New York*, pp. 57–68, and the remedies and preventives pointed out which were thought to be the most serviceable against it. In referring to protection by "cutting out the larvæ," it was stated: "When, however, thousands of the larvæ have to be destroyed in order to insure the crop, the method is quite unsatisfactory. It certainly is not reliable under the great increase of the insect in recent years, as stimulated by the increased cultivation of the Hubbard squash."

FIG. 1.—The Squash-vine borer, MELITTIA CUCURBITÆ.

I would now recommend its adoption *in the manner detailed below*, in connection with the means which Mr. Goff, of the New York Agricultural Experiment Station, found so successful, viz., "wetting the stems at a distance of two feet from the base of the plants with water containing Paris green at the rate of half a teaspoonful to a gallon, after every rain, from the middle of July to the first of September;" and as preventive of egg-deposit, placing in each hill four or five corn cobs dipped in coal tar, and redipping them from time to time during July and August.

With these methods faithfully employed, there would seem to be no necessity for failure in maturing a crop of squashes, so far as dependent upon the attack of its greatest enemy.

We give below an extract from a communication to the *Country Gentleman* of August 12, 1886, from Mr. H. C. Schmitz, of Albemarle county, Va., in which his manner of detecting the presence of the "borer," its extraction, and subsequent treatment of the vine, are detailed. The success that attended these measures are a sufficient recommendation for their general adoption.

Walking through the plantation at regular intervals, to operate immediately when action was wanted, I noticed the following signs as a certain indication of the presence of the borer.

The vine assumes a more or less yellow color, often the whole, sometimes only the portion near the main root; the leaves droop,

sometimes wilt badly. Generally the borer enters the main stem near the root, but often at the apex of the lower leaves, which then discolor, droop and wilt. If the borer has entered the main stem, now below the surface after repeated workings of the soil, the earth must be scraped away to the depth of two inches, more or less. The main stem on being pressed between the fingers, will be found soft and hollow, often nearly girdled from the inside. Here, with a penknife, I slit the stem, and proceed upward until the inside shows normal growth again. Often I have extracted from such a slit two or three specimens, measuring from one-fourth of an inch or less to one inch or more, some in the main stem, others having proceeded into side branches, even into the peduncles of the leaves. Next working with the knife downward in the direction of the root, you may find more. Let your work be thorough; be not satisfied with finding only one borer; lay bare to your eyes the whole inside of the stem as far as the borer has been feeding. One single borer left will absorb nearly all the sap flowing upward to feed the plant.

The squash vine calloses speedily if some dry dust is rubbed on the wound; then covering the injured stem with a little mound of fine soil, the sap flows again in its natural direction, and the plant recuperates soon. I have plants growing finely now where repeated incisions (the work was not done thorough from the start) had not left more than one-eighth of an inch of bark. If not layered already, layer immediately. The vine strikes root rapidly in mellow moist soil, and as yet I have never found a borer above the layer, nor a second attack in a callosed stem; and it might be a good preventive to slit the stem of the young plant from the root to the third leaf, sprinkle with mellow soil, and layer at the fourth leaf. Then again, I saw to-day some layered plants growing thriftily, where by repeated incisions and workings the main stem had been severed from the main root.

Change of Soil for Strawberry Plants.

At a meeting of the American Horticultural Society, Mr. Smith, of Wisconsin, stated that insects had been a great hinderance to him in raising strawberries, until he practiced setting the plants in soil that had not grown strawberries in several years, kept them well cultivated, raised one crop, and immediately plowed the vines under as soon as the crop was gathered, when he had no more trouble with insects. (*Country Gentleman*, Oct. 7, 1886, p. 753.)

Brine for the Currant-worm.

I am indebted to Mrs. Lucy T. Chrisman, of Chrisman, Va., for the communication of the following method of protection from the currant-worm, *Nematus ventricosus* Klug.

I have for three seasons gotten the better of the currant and gooseberry-worm by sprinkling the bush thoroughly, so as to wet each worm and the eggs under the leaves, with brine. It requires a pretty

strong brine to kill the worms — so strong as to kill the bush also unless it be washed off at once by a good wetting with pure water, when no harm is done to the foliage.

This method, if effectual, would be desirable for use against the second brood of worms that makes its appearance in July, if there is fear that the fruit might be dangerous for use from the application of hellebore.

Saltpetre not a Preventive of Cabbage-fly Attack.

In the *Second Report on the Insects of New York*, 1885, page 28, in consideration of statements quoted from agricultural journals of the complete efficacy of a solution of saltpetre in protecting from cut-worms and insects attacking squash and cucumber vines, it was recommended that experiments with this solution be made upon our smaller root insects, such as the radish, cabbage and onion maggots.

At my request, Mr. E. S. Goff, of the N. Y. Agricultural Experiment Station, has kindly made experiments with it upon the most injurious of the above insects, viz., the cabbage-maggot, with the following results:

I dissolved one pound of saltpetre in two gallons of water and poured about a gill of the solution around each plant, leaving alternate rows untreated. This was done on the first indication that the plants were infested, which was on May thirty-first. The application was repeated on June fourth, tenth and sixteenth. On June eighteenth, twenty-nine of the treated plants and twenty-six of those not treated were examined. On the former 124 maggots were found, and on the latter twenty-five. The treated row was the outside of the plat, which may account for its having been infested more than the others. I have frequently noticed that outside rows are more injured by injurious insects than the others. The experiment proved conclusively that nitrate of potash used in the strength and manner described, is not destructive of the maggot, as I repeatedly found the young, apparently just hatched, on the treated plants, as well as of all other stages of development.

In order to see if a stronger solution would avail, solutions of varying degrees of strength were tried, up to saturation, but the larvæ were able to endure the strongest.

We also tried the effect of mixing air-slacked lime with the soil at the time of setting the plants, but with no better success.

In view of the above experiments, it is not probable that the value of the saltpetre solution as a preventive of cut-worm injury, would be sustained by experiments as carefully conducted as were those of Mr. Goff. Its insecticidal properties, if it possesses any, have evidently been overstated.

Preventives of Cabbage-fly Attack.

The "cabbage-maggot"— the larva of the cabbage-fly, *Anthomyia brassicæ*, has proved a difficult insect to control. Various remedies and preventives have been given and suggested, none of which have been found to serve the desired purpose of affording entire immunity from its injuries in all localities. As the injury done to the plant is beneath the surface of the ground, it is evident that the efficacy of the proposed remedy may be materially affected by the character and condition of the soil in which it is employed. Several of the methods that have been found successful in preventing or lessening the losses from this great pest, or that promise success, will therefore be mentioned.

1. Tobacco dust, to be procured from tobacco factories, sprinkled freely over the young plants, is said to prevent the deposit of the eggs by the fly.

2. Mr. Peter Henderson claims that he has been able to prevent the ravages in his sample grounds where all the varieties of cabbages and cauliflowers are tested, by preparing the ground with a dressing of 150 bushels of oyster-shell lime to the acre. In one year when this had been neglected, and a formidable attack was made upon the plants about the middle of May, it was at once arrested, by scraping the soil from the stem of each plant, dusting lime around it and drawing up the ground again to the stem. In addition a handful of guano was dusted around every five or six plants. Strong roots were made above the wounds from the maggots, and the crop was saved. The lime preventive was the result of fifteen years employment in successful cabbage culture. Where the oyster-shell lime is not attainable, its equivalent in stone-lime may be quite as efficient. (*Rural New Yorker*, June 27, 1886, p. 433.)

3. When gas-lime can be obtained as a refuse from gas-works, if worked into the ground at a moderate depth after its exposure for a proper time, it will effectually prevent the operations of the maggot.

4. Ammoniacal liquor, another refuse from gas manufacture — diluted with twice its volume of water and poured around the infested plants in sufficient quantity to reach the roots, will kill the attacking larvæ. It will be a fine fertilizer, also.

5. A contributor to the *New England Homestead* has given this remedy: "Take green burdock leaves and stalks, run them through a hay-cutter, put them in a kettle or tub, and mash them with an old ax or mall, adding water and pounding them to a pulp. Let it stand over night. Have the decoction strong, and when you see the first sign of

the maggot, use it, and you will find it a dead shot for the maggot. Apply it with a sprinkler, taking off the nose, and pour the solution along the rows. I seldom have to apply it a second time." The same remedy is recommended for the onion-worm, and it has, to my certain knowledge, been proved effectual against the attack of the white-grub on strawberry plants.

6. A strong decoction of common tansy, where it is abundant, would probably be about as serviceable as the burdock.

7. A preventive of attack that has been used in England with good result, is, dipping the plants in a puddle of cow-dung or night soil, so as to smear the roots and stems well up to the leaves with the mixture.

8. Another English preventive is to dip the stems in thick soot and water. It appears to impart a bitterness to the plants that the maggots do not relish, and it is also found to ward off attack from grubs and cut-worms.

9. Hellebore gives promise of being as useful against the cabbage (and onion and radish) maggot, as it has proved in protecting tobacco plants from cut-worms. In the latter case, the young plants were dipped before setting out, in a solution of white hellebore in water—one-fourth of a pound in ten quarts of water. A gentleman in West Meriden, Conn., on June twenty-second, set 3,000 tobacco plants, and on the following morning he took from a row of 180 plants 214 cut-worms. On June twenty-fourth, he set out over 2,000 plants treated with the hellebore as above, of which he subsequently found but one plant eaten and that but slightly.

10. Avoid the use of fresh barnyard manure on cabbage ground, as that is believed to invite deposit of the eggs of the fly and to offer protection to the maggot.

Other remedies and preventives are mentioned in the *First Report on the Insects of New York*, 1882 (p. 190), in which an extended notice of the insect is given.

Beans for Repelling the Striped Cucumber Beetle.

The recommendation has often been made of planting beans in each hill with the cucumber seed, to repel the striped beetle. A writer in the *New York Tribune* has given his method of growing beans and cucumbers on the same ground, at first solely with the object of economizing space and labor by getting two crops from the same ground, but which gave the additional result of freedom from the beetle attack. The ground was marked three feet apart each way with a corn plow, and butter beans and cucumbers or melons were

planted alternately in one row, and in the next all beans, thus making the melons six feet apart each way. The string beans were out of the way in time for the melons to occupy the ground. Previous to adopting this method, it had been found necessary to go the rounds every morning before sunrise and kill the beetles, and even then they could not be kept under control.

Gas-lime for the Woolly-aphis.

It appears from Bulletin No. 55 of the University Experiment Station at San Francisco, Cal., that the experiments made with gas-lime for destroying the woolly-aphis of the apple tree, *Schizoneura lanigera* (Hausm.), the root form of which is represented in Fig. 2, have shown the value of this insecticide for the destruction of a pest, hitherto almost beyond our control. In the experiments made about four years ago, an application of ten pounds of the lime to a tree had killed the aphis infesting the roots, but at the same time, some of the trees standing on shallow soil had been killed by the application, and the general results were therefore reported as not satisfactory, the more so, as the aphis was subsequently seen descending to the roots. Since that time it has been found that only the badly located or weak trees had been killed, and that the aphis had not reinfested the roots, but existed only at the surface of the ground. Later experiments with the gas-lime differently applied, gave very satisfactory results, in entirely arresting the aphis attack, without injury to the trees. Instead of removing the soil and putting the gas-lime in close contact with the tree, as done the first time to the corrosion of the bark, about a shovelful and a half (two or three pounds) in a dry state were distributed over the surface in a radius of four feet, trusting to the rain to carry it into the soil. A few shovelfuls of fresh ashes were piled close about the trunk to prevent the aphis from congregating on the crown.

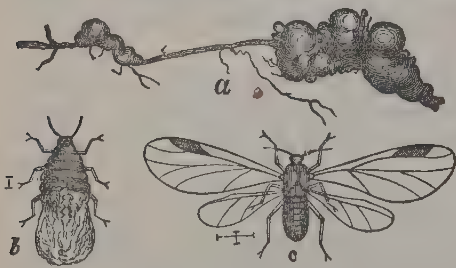

Fig. 2. — The apple-root plant-louse, Schizoneura lanigera; *a*, the knotted root; *b* and *c*, wingless and winged larval forms.

How to Kill the Apple-tree Aphis.

A correspondent had asked for an effectual cure for green lice or aphides on the leaves of apple-trees. He had used kerosene, tobacco and strong soap-wash, each of which had killed the lice, but others appeared very soon in apparently greater numbers than at first.

Answer was returned that it was not difficult to kill the apple-tree aphis, *Aphis mali* Fabr., shown in Fig. 3, and to arrest the attack, if the means be used at the proper time, with proper apparatus, and in the right manner, as herewith given:

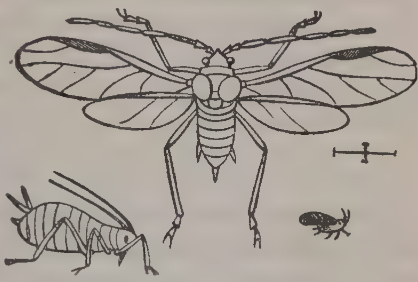

Fig. 3.—Apple-tree aphis, Aphis mali; winged and wingless forms.

1. *The proper time* to attack the aphis is early in the spring, before the trees are in leaf. Later, many of the insects will be so protected in the folds and curls of the leaves that the applications can not reach them, and contact with the insecticides is essential to their destruction, since they can not be killed by poisoning the foliage of the tree, as their food consists only of its sap. The best time to reach the pest is during the late autumn or winter, when, if the leafless trees be thoroughly sprayed with a kerosene emulsion, the eggs will be killed. The emulsion may be made by violently agitating (through the use of a force-pump or otherwise) until in a homogeneous mass, two gallons of kerosene to one gallon of a hot soap solution, made by dissolving half a pound of common soap in one gallon of water. For use, dilute with nine parts of water — a quart of the emulsion to nine quarts of water, or in the same proportion.

The best time to kill the aphis, if it has been neglected in the egg stage, is just after its hatching, while still gathered upon the unopened buds and portions of twigs adjoining. Without the work of preparing the kerosene emulsion, which involves considerable labor, most if not all may be killed at this time by spraying with strong soap-suds or a tobacco solution, say half a pound of tobacco to a gallon of boiling water. As these solutions often fail to kill the old matured aphis, and as it matures in about ten or twelve days after hatching, a second spraying, and a third if found to be necessary, should follow at about a week's interval.

2. *The proper apparatus* to be used is a force-pump of sufficient power (no farmer or fruit-grower can afford to be without this implement), and a nozzle which will distribute the liquid in a fine spray or mist. There are a number of nozzles which will accomplish this which have been made for use in large orchards. Among these, the most popular ones are the Nixon Climax nozzles, made by the Nixon Nozzle Company, at Dayton, Ohio; the Boss nozzle, and the Graduating Spray nozzle. The Hallowell Brass Company, of Lowell, Mass., have recently put upon the market an atomizer and a nozzle which promises very efficient

work. Suitable pumps may be had of the Field Force Pump Company, of Lockport, N. Y.; Goulds Manufacturing Company, at Seneca Falls, N. Y.; Rumsey & Company, also of Seneca Falls, and P. C. Lewis, of Catskill, N. Y. Each of the above firms will readily send illustrated circulars giving style and prices of their pumps and spraying apparatus from which selection may be made.

3. *The right manner* of applying the insecticide, when employed against plant-lice, is, that it shall be made to reach every insect. This is not essential when the canker-worm and other caterpillars which feed by means of cutting jaws upon the poisoned foliage are to be killed. The finer the spray can be delivered from the nozzle, the more effective is it against the aphis. Other advantages of fine spraying are, economy in the material used, and, in the case of arsenites, less danger of poisoning stock that may enter the orchard before heavy rains have occurred, by the dripping of the liquid from the trees upon the grass. If London purple be used instead of Paris green (with which it is equally effective) of a dilution of one pound to 150 gallons of water, and the spraying be discontinued as soon as the trees commence to drip, danger in this direction will be very little, if any.

Tobacco Dust for Aphis Attack.

Mr. Peter Henderson, the experienced and well-known horticulturist of Jersey City Heights, N. J., has lately published his method of dealing with the plant-lice or Aphides that are so injurious to roses, grapevines, chrysanthemums, and hundreds of other species of plants cultivated both in the open air and under glass. While the antidote used by him is not new, his method of application may not be generally known. It is as follows:

"A certain remedy is to apply tobacco dust with a bellows when the leaves are wet, at least once a week — twice is better. We have used this as a preventive remedy for many years with the most excellent results on all plants subject to aphis.

"The main reason why remedies fail is owing to the fact that they are rarely long enough persisted in. One or two applications may check the trouble, but will check it only. My rule for these pests is prevention, which need never fail, if the remedy is steadily applied.

"In our new practice every kind of plant that we know to be liable to be attacked by aphis is dusted over with tobacco dust twice each week from June to October. Of course at such times as the roses or chrysanthemums are in flower, or when the fruit of grapes is ripening, it must not be used, but these conditions only occur for a short season, and there is no necessity for using the dust in winter, as then

fumigation with tobacco stems kills the aphis." (*Popular Gardening*, for December, 1887, iii, p. 50.)

We have omitted from the above the references to prevention of mildew, by mixing one part of black or virgin sulphur to nine parts of the tobacco dust.

A Lime Wash for Bark-lice.

The following application has been recommended for the destruction and removal of scale insects infesting fruit trees. The materials named are certainly sufficiently powerful to accomplish the purpose, and the omission of one or two of the number would not, it would seem, impair the efficacy of the wash. It is as follows:

Slake stone lime, as for whitewash, and to two-thirds of a bucketful add one pint of gas-tar, one pound of whale-oil soap dissolved in hot water, one pound of common soft soap, one pound of potash or one pint of strong lye from wood ashes, and also clay or loam enough to make the wash of proper thickness to be applied with a whitewash brush.

It is also claimed for the above that it is an effectual remedy and preventive of the peach-tree borer, if the earth be removed from the collar of the tree and thoroughly applied about the base; also, that if the trunks of apple trees are coated with it, it will prevent the operation of the striped apple-tree borer.

INJURIOUS HYMENOPTERA.

Nematus Erichsonii Hartig.

The Larch Saw-fly.

(Ord. Hymenoptera : Fam. Tenthredinidæ.)

Hartig: Die Familien der Blattwespen und Holzwespen, 1837, p. 187, No. 9 (original descr.); in Stett. Ent. Zeit., i, 1840, p. 22.

Ratzeburg: Forstinsekten, iii, 1844, p. 121, pl. 3, f. 4.

Hagen: in Canad. Entomol., xiii, 1881, p. 37 (identified in U. S.); in Rept. Comm. Agricul. for 1883, p. 141–2.

Packard: in Rept. Comm. Agricul. for 1883, p. 138, pl. 3, f. 1, pl. 13, figs. 1–4 (history, habits, descr.); Bull. No. 3, Div. Entomol.—U S. Dept. Agricul., 1883, p. 29 (in Maine); in Rept. Comm. Agricul. for 1884, p. 377 (operations); in Amer. Nat., xviii, 1884, pp. 293–296, figs.; in Rept. Comm. Agricul. for 1885, p. 321 (operations); in Bull. 13, Div. Ent.—U. S. Dept. Agricul., 1887, p. 20; Entomology for Beginners, 1888, p. 166, f. 207.

Fletcher: in Canad. Entomol., 1884, p. 215 (distribution in Canada; in Rept. Min. Agricul. for 1884, p. 215 (distrib.); in 15th Rept. Ent. Soc. Ont., 1885, p. 22 (ravages of), pp. 72–77; Rept. Entomol. for 1885, p. 28; id. for 1887, p. 35.

Fyles: in 14th Rept. Ent. Soc. Ont., 1884, p. 17 (in Canada); in Canad. Entomol., xv, 1884, p. 216.

Provancher: Addit. Faun. Hymenop. Can., 1885, p. 5, f. 1; in Nat. Canad., xv, 1885, pp. 45–53, figs. 8–11 (general notice).

Harrington: in Canad. Entomol., xxiii, 1886, p. 39.

Lintner: in Entomolog. Amer., iii, 1887, p. 121 (in N. Y.); 4th Rept. Ins. N. Y., 1888, p. 16· in 18th Rept. Ent. Soc. Ont., 1888, p. 32.

Jack: in 17th Rept. Ent. Soc. Ont., 1887, p. 16.

Cresson: Synop. Hymenop. N. Amer., 1887, p. 158.

Saunders: in 18th Rept. Ent. Soc. Ont., 1888, p. 31 (in Nova Scotia and New Brunswick).

The larch saw-fly is a recently introduced pest, having been brought from Europe, it is believed, into Massachusetts not long prior to the year 1880 on some European larches. It has displayed a disposition for rapid distribution, as it has within the decade spread and carried its ravages over a large part of New England, Canada, and the State of New York. It will in the near future probably extend its range over all that portion of the country where its food-plant, the larch, occurs. Originally feeding in Germany on the *Larix*

Europœa, it seems to have found our native species, *Larix Americana*, commonly known as the tamarack or hackmatack, particularly adapted to its tastes, as shown in the havoc which it inflicts in the tamarack swamps of New York and New England.

The insect is illustrated in Fig. 4. For details of life-history, and its description, reference may be made to the writings of Dr. Packard in the reports of the Commissioner of Agriculture, above cited. For

Fig. 4.—The larch saw-fly, Nematus Erichsonii, in natural size and enlarged, and the larch worm of different ages, in natural size. (From Packard.)

the present it will suffice to say that the parent saw-fly emerging from her cocoon in the month of May, probably not long thereafter resorts to the larches and inserts its oval, cylindrical eggs, according to Dr. Packard, in two rows of incisions in the terminal shoot or one of the side shoots, causing a twisting and deformity therein from the presence and growth of the eggs. The larvæ, hatching in June, mature rapidly, "in from five to seven days, or not more than ten," when they descend from the trees and inclose themselves within their elongate oval cocoons beneath moss or other convenient shelter. This occurs the last of June or in early July, in New York. They remain unchanged within the cocoon during the winter and assume the pupal form the following spring, as is the habit of many of the *Tenthredinidæ*.

The Insect in Europe.

Ratzeburg, in his celebrated work on Forest Insects, notices the occurrence of this insect in Germany and in other parts of Europe. It had appeared on the larch in the Hartz mountains and in the plains of Holstein, in sufficient numbers to attract the attention of forestry officers, and it was feared that it might become injurious. According to Dr. Hagen, it had only been observed as obnoxious to the larch twice before 1840, and was very rare in Europe. It was not among the extensive collections of European insects brought thence by him to the Cambridge Museum.

Its Appearance in the United States.

In the year 1880, Professor C. S. Sargent, Director of the Arnold Arboretum at Brookline, Mass., discovered larvæ feeding upon some European larches, *Larix Europœa* growing in the vicinity. They were submitted to Dr. Hagen, of the Museum of Comparative Zoölogy at Cambridge, and identified by him, from the description and figures of Ratzeburg, as *Nematus Erichsonii* Hartig. This is the first record of the appearance of this saw-fly in this country, which soon thereafter developed destructive powers entirely foreign to its European character.

Its Spread throughout New England.

It is reported as having been injurious to larches in the State of Maine, in 1881, and in 1882 its operations were observed by Dr. Packard, during the month of August, in the vicinity of Brunswick, Me., as detailed in his "First Report on the Destruction of Evergreen Forests in Northern New England," *loc. cit.* The same year, it also appeared in New Hampshire.

Its Occurrence in New York.

The following year (1883) about July twenty-fifth and early in August the effects of the insect were observed at Horicon and Pottersville, Warren county, and at Schroon lake in Essex county. By the first of August the trees had been defoliated. The region affected was very extensive, covering many square miles in different swamps. It was also reported "from Schroon lake to North Elba and about Mount Marcy." (Packard.)

During the years 1884, 1885, and 1886, the same attack upon the larches, or tamaracks, as they are more generally called, was observed by State Botanist Peck, in several of the counties of Northern New York. The notes kindly given me of the place, time and degree of injury wrought, were intrusted to a friend for his use and have been unfortunately lost, so that the details can not now be put on record.

In St. Lawrence county.— June 29, 1887, larvæ of this species were received for name from Dr. E. L. Sturtevant of the State Agricultural Experiment Station, which had been sent to him by Mr. E. Phelps of De Kalb Junction. When the package was opened the following day, one of the larvæ had already inclosed itself in its cocoon. It is believed that this is the earliest recorded date of larval maturity. The following notice taken from the *St. Lawrence Republican* of July 27, 1887, will give some idea of the immense number in which the "worm" made its appearance:

Mr. David Page of Jerusalem Corners, in this town, has given us an account of a remarkable pest of worms which recently infested his premises. There are three larch or tamarack trees growing in his door yard. About July seventh, very soon after the extremely hot weather set in, a few worms appeared upon them, feeding upon the leaves. The next day they had doubled in number, and in a day or two had become a countless host, completely covering the trees, so that the end of the finger could not be placed even on the trunk of one of them without touching one or more of the worms. They also covered apple and maple trees and shrubbery, and the grass beneath, but ate nothing, so far as could be discovered, except the leaves of the tamaracks. They swarmed upon the house and piazza, and it became necessary to sweep them from the latter every few minutes. They accumulated in little windrows along by the house. The countless hordes of worms became an object of great curiosity and interest to people of the neighborhood, and Mr. Page and his family became really alarmed as to the result of this invasion; but in scarcely a week from the time of their first appearance they disappeared as rapidly as they had come, and in a day or two none of them were to be found. The tamaracks were left as bare as in winter, but no other signs of damage were visible. Whether the worms had gone into the ground or what had become of them seems not to have been ascertained.

In Otsego county.— Other examples of the larva and two of the cocoons were received by the State Entomologist, July ninth, from Rev. Henry U. Swinnerton, of Cherry Valley. He has kindly furnished, on request, some observations made by him, extracts from which are herewith given, as showing interesting habits of migration, etc. of the larvæ, when occurring on isolated trees. Under date of July ninth, he wrote:

I send you specimens of a worm that has appeared in considerable numbers on a larch tree on the lawn of Mr. Lansing, my neighbor. They began dropping off in a pattering shower, and are migrating towards some maples not far off.

Additional particulars of the migration were furnished under date of July twelfth:

The larch saw-fly worm seems to have disappeared, and within a very limited distance from the tree from which they started. They crept in an easterly direction diagonally toward the street, about

thirty feet from the tree. Several maples in the track were invaded. Salt was strewn on the flagstones to kill them, but many reached the maples outside. I do not find that a single one crossed the road. Where they disappeared to I can not imagine.

I know of but four larches about the village — two of them fine, good-sized trees. Of two smaller ones, one quite small, had some of the worms upon it, and the foliage shows that it had been eaten, but only a little. The other is embowered among maples, and does not seem to show any injury. But the two large trees are very much stripped, only a few of the lower branches retaining any foliage. The second of them is on Miss Roseboom's place. * * * * In this case also, the worms crept in an easterly direction, going up a pine, some hemlocks, and a horse chestnut —" millions of them," as I am told.

I had a man climb both the larch and a maple at Mr Lansing's in search of the saw-flies, but he could find hardly one. We then began to discover apparently dead ones, then a few living ones. But it seemed surprising that so few should be discoverable. Further search revealed more living ones just beneath the ground and among the moss at the roots of the tree, especially under the larch. Finally we were led to conclude that the brown cocoons, of which there seemed to be a great number, must belong to them. I inclose the whole collection in a box and send it to you. * * * * It was only last Thursday (July seventh), that the worm was first observed.

A diagram of a portion of the village accompanied the above communication, showing streets, residences, the location of the trees, direction of the migrations, etc. — evincing the interest excited by the appearance and movements of the new visitor.

In Schoharie county.— The following paragraph from the *Country Gentleman* of July 14, 1887, refers, without doubt, to the operations of the larch saw-fly larva.

The tamarack trees in this section are infested with multitudes of rather small, green worms with black heads, which are stripping them of their foliage.— *Sharon Centre, N. Y.*, July 8, 1887.

Personal Observations in Hamilton County.

During a visit to the southern portion of the Adirondack region, July fourteenth to August fifth, the opportunity was offered of making a few observations on this insect. The season at this time was too far advanced to note the attack either at its commencement or its height. All of the larches within sight of the stage route from Newton's Corners, at the foot of Lake Pleasant, to Sageville at its head, a distance of four miles, had been almost entirely stripped at the earliest date above named. The trees of this species of which there are many, in some places it being the prevailing growth, could be recognized at the greatest distance from which they could be seen by their

nakedness, appearing as if dead, which undoubtedly some of them were, as the result of previous defoliation. The elevation above tide of Lake Pleasant is 1,800 feet.

No information could be obtained of residents of the time when the injury to the larches had first been noticed. To many it seemed quite new when their attention was at this time called to it, although it might probably have been observed during the two or three preceding summers.

Very few of the larvæ were to be found on the trees on the nineteenth July, and as most of these were apparently but about half-grown and of a pale green color, as if recently molted, it is not improbable that they were belated, sickly, or parasitized individuals which were destined not to attain maturity.

Not all of the larches in the vicinity had been wholly stripped. A large one of eighteen inches in diameter at three feet from the ground and reaching upward to a height of at least seventy feet, standing alone in a pasture lot, and throwing out long and thick branches, had its foliage less than one-half eaten. From a large number of larches of a moderate height — of fifteen feet and under — that were entirely free from harm, it appeared that the younger trees were not sought by the parent saw-fly for oviposition. Whenever they had been eaten, they were in the immediate vicinity of larger trees, which, having been stripped, the migrants from them, in their search for food, may have been able to ascend, with difficulty, in small numbers, such of the smaller ones as chanced to be in their way. The tips of these small larches, gave no evidence of oviposition in them.

Cocoons.— Cocoons, in some instances only, were found underneath the trees where search was made for them, but not at all commensurate with the immense number of larvæ that had evidently been present. Is it the habit of the larva to wander from the feeding-ground to some distance in search of a favorable place for pupation? Do they leave the tree for the purpose at about the same time, after the habit of some of the Lepidoptera, as, *Datana ministra* and *Œdemasia concinna;* and if so, is this the explanation of the "migrations" previously mentioned? Most of the cocoons collected were taken from underneath moss growing around the borders and in cavities of rocks. A large proportion — about ten per cent — had been eaten into at one end and the larva consumed.

Parasites and Enemies. — From the number of ants that were noticed in association with the cocoons, it was thought that the credit for this destruction might be due to them. With so active an enemy travers-

ing the soil in every direction, but few of the larvæ could be expected to survive the winter.

A *Podisus* pupa (one of the large plant-bugs) was taken July nineteenth from the trunk of a tree feeding on one of the saw-fly worms. It was subsequently fed in confinement on *Nematus* and *Haltica bimarginata* larvæ to the imago stage, which it assumed July thirtieth, when it proved to be *Podisus modestus* Dallas. In fastening upon its prey, in almost every instance observed its proboscis was inserted near the anal end of the larva. Full-grown forms of both species were fearlessly seized and firmly held by it until their fluids were exhausted. The larvæ collected were remarkably free from parasitic attack. A single small white cocoon, apparently of a *Microgaster*, was obtained from a half-grown example.

Larvæ failed to mature. — Although rather large collections were made of the cocoons (several hundred) at Sageville, not one of them gave the imago the following spring, although they were carefully secluded from light and given a damp atmosphere from water evaporated underneath the breeding-case during most of the autumn and winter. Failing to disclose the imago in due time, a number of the cocoons were opened, when each was found to contain the shriveled remains of the larva — none having reached the pupal stage.

The Hibernated Insect from Cherry Valley, N. Y.

In consideration of the above failure to obtain examples of the perfect insect for the State collection, request was made of the Rev. Mr. Swinnerton, of Cherry Valley, for some hibernated cocoons, if procurable, from underneath the infested larches of last year. A number were received, on May 1, 1888, which, upon opening a few, disclosed the living insect in its pupal stage. On May eighth, four of the saw-flies emerged, and the following day, eighteen others — all of which, except one, were females. No others appearing, the remaining cocoons were opened for examination, and gave a half-dozen dead matured females, and from one within a slight inner cocoon, the pale yellow-green pupa of a large ichneumon fly, believed to be a *Pimpla*, was taken, and cared for, but failed to develop.

That additional males, and knowledge of the relative proportion of the sexes, and perhaps other parasites, might be obtained, request was made of Mr. Swinnerton for another sending of cocoons, if not too late for finding them with living pupæ. The larger number were reported open at one end and empty. Of the few that were received on the eighteenth of May, twenty had given out the insect when

examined on the twenty-third, four on June first, and six others by the eighth of June — the latest date of emergence.

Disparity of sexes.— Of fifty-eight examples of the fly examined, only *one* was of the male sex. Is it possible that the cocoons were not received in season (May first) to secure the males, which ordinarily are the first to make their appearance? Still, in rearing, in July, 1888, from the larvæ collected on or about a poplar (*Populus monilifera*) a number of the poplar saw-fly, *Aulacomerus lutescens* Lintn., a marked disparity in sexes was also observed, although not so great as in the larch saw-fly, above. Of fifty-two examples of this species reared, only six were males. It is easy to carry through to its perfect stage the first brood of this insect, and the conditions, therefore, attending it within doors should so nearly approach those in nature that the results should be almost the same.

Injuries from the Insect.

In August, the larches observed in the Lake Pleasant region which, during the preceding month had been entirely denuded, had commenced to put forth new leaves. This was probably the second year's defoliation of many of the trees. It is doubtful whether they would be able to survive the repetition of the injury for another year. In Maine and Canada, where the insect has prevailed quite generally since 1884, the larches over large areas have been killed, and it is the opinion of foresters that the entire loss of the foliage in early summer, for three consecutive years, proves fatal with very few exceptions.

The addition to our list of insect pests of one which threatens the entire destruction of a tree so valuable as the larch, can not be regarded otherwise than in the light of a serious calamity. It would appear, at the present, that this evil is destined to become more general than the destruction of the spruce (the timber of which is of so great economic importance) in many localities in northern New York, for the latter, as yet, is but a local (?)disease, and may therefore prove, when satisfactorily accounted for, to be the result of purely local causes. There is hardly a doubt but that the range of this new pest will be almost co-extensive with that of the larch, viz., over a large portion of the northern United States and the adjoining British possessions, even into the Arctic region.*

* Northern Newfoundland and Labrador to the eastern shores of Hudson bay, Cape Churchill, and northwest to the southern shores of the Great Bear lake and the valley of the Mackenzie river within the Arctic circle; south through the northern States to northern Pennsylvania, northern Indiana and Illinois, and central Minnesota. (Sargent's *Report on the Forests of North America.*)

The wood of the larch is given by Prof. Sargent as "heavy, hard, very strong, durable in contact with the soil; preferred and largely used for the upper knees of vessels, for ship timbers, fence posts, telegraph poles, railway ties, etc." L' Abbé Provancher, in his notice of the larch saw-fly above cited, in which he regards it as threatening the entire disappearance of this precious tree of the Canadian forests, since from the first notice of the insect in America in 1880, it had already in the year 1885 spread with such remarkable rapidity and destructiveness, that "from Halifax to Ottawa, and perhaps even beyond, there is not to be seen in July and August a single larch having its foliage intact"—has written as follows of this tree and its value:

It is known that this tree grows in wet or marshy lands, where the soil ordinarily is of poor quality. Among its roots, which it sends out horizontally at a moderate distance from the surface of the ground, there is always to be found, on one side or the other, one that is much larger than the others. It is often said that this tree has but a single root, the others being only ramifications of it. As this root forms a right angle with the trunk, and as the wood is very strong, very slightly brittle, and almost free from decay, it is the prized source for the elbows and knees that enter into naval constructions. In addition to its being an excellent fuel, this wood is also desirable for a multitude of uses, as for boat-bottoms, joists for buildings, fence posts, etc. The larch forms also a very handsome ornamental tree; its elliptical cones of about an inch in length, of a beautiful purplish-violet shade, and ordinarily a great number on the same tree, give a charming effect, when in June they join themselves to the delicate foliage, simulating fringes or sparkling bouquets of so lively a green that the sun seems powerless to change it. And besides the graceful picture that it presents, the tree perfumes all its surroundings with a resinous odor which is most agreeable.

Remedies.

When the larch occurs as isolated trees or in groups of moderate extent, it is an easy task to save its foliage from destruction by the saw-fly larva. The attack of its hosts is quickly noticeable, and if they are then shaken or beaten from the branches they may be crushed under foot or with a roller. Of those that may escape very few will succeed in ascending the trunk, since, although the Nematus larva is bountifully provided with legs, having twenty, while most of the caterpillars of butterflies and moths have but sixteen, yet these organs are not developed to the extent of making them suitable for easy climbing. Or, the worms may be killed by spraying the foliage with Paris green or London purple in water, according to directions so often given.

When large areas of the larch are infested, as tamarack swamps, it will be useless to attempt to compete with the enemy. Its destruction through any applications that might be made would be altogether too costly to warrant the outlay required. The best that could be done in such cases would be to fell the trees as soon as it is noticed that they are dead or doomed, and before decay has impaired their value, and use them for some of the many purposes for which the timber is available.

Nematus salicis-pomum Walsh.

The Willow-apple Gall Saw-fly.

(Ord. Hymenoptera : Fam. Tenthredinidæ.)

Walsh : in Proc. Ent. Soc. Phil., vi, 1866, pp. 255–256 (description of gall, larva, imago, etc.).

Norton : in Trans. Amer. Ent. Soc., i, 1867, p. 216–218 (description of larva and imago).

Walsh-Riley : in Amer. Entomol., ii, 1869, pp. 45–49, f. 30 (general account).

Cresson : Synop. Hymenop. Amer., 1887, p. 159 (cited).

The galls of this tenthredinid were observed June twenty-seventh, at West Albany, N. Y., on willow, *Salix cordata.* Several of them had been eaten into, making an irregular funnel-like cavity. One that was opened for examination had the interior wholly consumed and contained, instead of the Nematus larvæ, four small white, legless grubs, which were probably those of a "guest-beetle," named by Mr. Walsh, from its appropriating the gall of another insect, *Anthonomus sycophanta;* another, which had been but partly eaten, contained one of these larvæ. The eaten galls were more rosy-cheeked than the others. None of the larvæ were carried to maturity, their failure to mature being, doubtless, the result of the galls having been collected so early.

An extended account of this willow-apple gall (with illustration), and of the three guest-insects that usurp its shelter and its food, is to be found in the *American Entomologist* (loc. cit. sup.). In it, Mr. Walsh states that the eggs of *N. salicis-pomum* are deposited in a slit of the willow leaf toward the end of April. The larva attains maturity during the last of July ; it pupates within the gall, where it, hibernates, and the winged insect emerges in April — from the sixteenth to the twenty-fifth, as in large numbers, reared.

INJURIOUS LEPIDOPTERA, ETC.

Darapsa Myron (Cramer).

The Green Grapevine Sphinx.

(Ord. Lepidoptera: Fam. Sphingidæ.)

Sphinx Myron Cramer: Pap. Exot., iii, 1782, pl. 247, f. C.
Sphinx pampinatrix Sm.-Abb.: Lep. Ins. Geo., i, 1797, p. 55, pl. 28.
Otus Myron Hübner: Verz. Schmett., 1816, p. 142, No. 1524.
Otus Cnotus Hübn.: Zutr. 3d Hund., 1823, p. 23, figs. 321, 322.
? *Smerinthus Myron:* St. Farg.-Serv.: in Encyc. Method., x, 1823, p. 441.
Everyx Myron Boisduval: in Sp. Gen. Heteroc., i, 1836, p. 209.
Chœrocampa pampinatrix Harris: in Sill. Journ., xxxvi, 1839, p. 301.
Darapsa Myron Walker: List Lep. Br. Mus., Pt. viii, 1856, p. 183.
Ampelophaga Myron Grote: in Canad. Entomol., xviii, 1886, p. 132.

Above are given the various names under which this common and injurious insect appears in our literature.* Of these, the name bestowed upon it by Dr. Harris was expressive of the appearance and habits of the caterpillar *chœrocampa*, meaning, in the Greek, "the hog caterpillar," and suggested by the fancied resemblance of its front segments to the head and snout of a hog (see Fig. 5), and *pampinatrix* signifying, in the Latin, "a vine-pruner." Scientific names should, whenever possible, indicate some feature, character, habit, or peculiarity of the object or creature to which they are applied, and it is, therefore, to be regretted that the one selected by Dr. Harris for this insect could not have been retained, but in obedience to the law of priority, the specific name given to it by Cramer fifty years before must be substituted for it, although a mere chance-chosen proper name. The six different genera to which it has been referred since Cramer's time illustrates the lamentable want of fixity in generic appellations — an evil which we will have to endure so long as there are those among us who are seemingly goaded by an irresistible impulse to cut to pieces the old genera, and to endeavor to give vitality to new. It is a sore evil, fettering science, and tending to impede its progress instead of aiding in its advance. Favored above

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* Other bibliography of the species is omitted in consideration of its extent.

many is he, who, as he scans these long lists of uncalled-for, short-lived, often still-born genera, can exultingly say: "I thank God that I baptized none of you!"

A Common Insect.

Darapsa Myron (as we prefer to call it for the present) has a distribution over a large portion of the United States, being found in all the region east of the Mississippi river, in some of the States west thereof, and in Canada. The caterpillar occurs oftener on the grape than any other of the Sphinges having the same food-plant, viz., *Thyreus Abbotii* Swainson, *Deilephila lineata* (Fabr.), *D. chamœnerii* Harris, *Philampelus Pandorus* (Hübner), and *P. achemon* (Drury). It is made the more conspicuous by the parasitization to which it is peculiarly liable, and when in this condition its larval existence is considerably prolonged — not maturing and pupating as it otherwise would.* For these reasons it frequently comes under the observation of the grape-grower, exciting his curiosity, and causing it to be sent to the entomologist for information regarding it. The following notice will meet some of these inquiries.

The insect may be readily identified from the description and figures herewith presented.

Description of the Caterpillar.

Young Larva.— After its first molting it measures one-half inch in length. It is of a light green color, with the usual oblique lateral bands of the Sphingidæ running into a yellow subdorsal line. Along the body dorsally is a series of triangular yellow spots, which, on the sixth and seventh segments, are centered with orange. The caudal horn is green, straight, and two-tenths of an inch long ; it continues to be straight through following moltings until after the last — the fourth molt, when it assumes the usual curved form.

Mature Larva.— The head is small, oval, pale green, with numerous yellow granules and four yellow perpendicular lines. The body is swollen on the third and fourth segments, tapering rapidly thence to the head. Its color is yellowish-green, speckled with numerous pale yellow dots. The seven oblique lateral bands cross the

* "It is one of those remarkable and not easily explained facts which often confront the student of Nature, that, while one of these hog-caterpillars in its normal and healthy condition may be starved to death in two or three days, another, that is writhing with its body full of parasites, will live without food for as many weeks. Indeed, I have known one to rest three weeks without food in a semi-paralyzed condition, and, after the parasitic flies had all escaped from their cocoons, it would raise itself and make a desperate effort to regain its strength by nibbling at a leaf which was offered to it." (Riley.)

spiracles and connect above with a white stripe which borders a dark green subdorsal line extending from the lateral stripes of the head nearly horizontally to the tenth segment where it curves upward to the caudal horn; on the three anterior segments the subdorsal line is bordered beneath with yellow. Usually on the back are five or six pale green or yellow spots of which the base of each rests on the anterior portion of the segment, and the apex on the posterior, having within them a lozenge-shaped dull rose-red spot resting on the anterior margin. The spiracles are orange colored, with a white spot at each end. The caudal horn is curved, one-fourth of an inch long, bluish-green, granulated in black in front and in yellow behind, and with a yellow tip. Length of caterpillar, two inches.

Fig. 5.— The grapevine hog-caterpillar, Darapsa Myron.

A short time before its pupation, the color changes to a dull rose throughout, with the white lateral and the subdorsal bordering bands of a clearer rose. Previous to this change of color, I have observed the caterpillar to pass with its mouth over the entire surface of its body and of its horn even to the tip, applying to it a coating of what seemed a glutinous matter — the operation consuming about two hours. *

Its Injuries.

Although often a serious annoyance in vineyards, it does not in its general behavior merit the bad reputation given to it by Dr. Harris. He says of it: "Not content with eating the leaves only, it stops at every cluster of fruit and, either from stupidity or disappointment, nips off the stalks of the half-grown grapes and allows them to fall to the ground untasted. I have gathered under a single vine above a quart of unripe grapes thus detached during one night by these caterpillars."

* *Proceedings of the Entomological Society of Philadelphia*, iii, 1864, p. 663.

Usually Destroyed by a Parasite.

No effectual method is known by which to protect the grapevine from these caterpillars, and resort must therefore usually be had to hand-picking. But in collecting and destroying them care should be taken to save from destruction those which have attached to their body a large number of small oval white objects resembling eggs (see Fig. 6) and generally mistaken for them. They are not eggs but the pupal-cases of the parasite — the natural enemy of this caterpillar. So faithful is it to its mission that very few of the caterpillars escape its persistent search and reach maturity. Perhaps nine out of ten are destroyed by it. The parasite is a small four-winged fly, belonging to the parasitic family of *Braconidæ*, and is probably *Apanteles congregatus* (Say).* Having discovered one of the caterpillars, it pierces its body in numerous places, depositing an egg in each wound. These in due time hatch out into grubs within the caterpillar, where they feed upon its interior, instinctively avoiding the consumption of the vital parts that their food may continue to be suitable for them. Usually after the last molting of their host, while to all outward appearance it is uninjured and thriving, although careful observation may have shown it to have refrained from feeding for several days, all at once a host of little heads may be seen eating their way through the skin of its back and sides. Within an hour's time the entire brood of grubs — a hundred or more it may be in number, have wriggled outwardly, and with their terminal segment fastened to the body by a few silken threads spun for the purpose, commence building about them their small firm, egg-like, snow-white cocoons, which, securely attached and standing on end are usually so numerous as to cover all of the upper part of the body and the sides of their victim. In two or three hours, they are all inclosed.† In about a week, the grubs have completed their rapid transformations, when a neatly fitted lid is pushed open at the top of each little cocoon, pressed to one side, and the

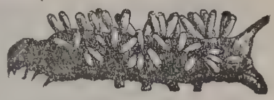

Fig. 6.—Caterpillar of Darapsa Myron bearing the cocoons of the Microgaster parasite.

* I have had the same parasite from larvæ of *Thyreus Abbotii*, *Philampelus Pandorus*, and *Sphinx kalmiæ* — the last not a grapevine feeder.

† For an interesting account and graphic illustration of the peculiar manner in which these Microgaster cocoons are spun on the body of Philampelus (and probably on D. Myron also), see an article in the *American Naturalist* for 1878, vol. xii, pp. 558–560, by Mr. J. P. Marshall.

perfected parasite escapes. I have had them emerge as early as the twenty-fourth of August. The victimized caterpillar, now in a flaccid, shriveled condition, lives for a few days, without food or motion, and dies.

Insect Friends and Foes.

The above history should furnish an argument in favor of such a diffusion of entomological knowledge as may enable the agriculturist, fruit-grower and florist, to discriminate between his insect friends and foes. If, from ignorance, one should crush under foot one of these parasitized creatures believing it to be a ravenous caterpillar bearing hundreds of its eggs(!) upon its back, thinking thereby to check its increase (and this procedure we fear is the rule that prevails), he has taken the best possible means of promoting its multiplication by destroying the natural enemy whose special mission it is to prey upon it.

Pupation.

The larvæ that are so fortunate as to escape parasitic attack spin closely together a few leaves on the surface of the ground, within which they change to pupæ in three or four days.

The pupa is from one inch to an inch and two-tenths long and about one-third of an inch broad. It is without the projecting tongue-case of many of the sphinges. Its pale brown color is a distinguishing feature. The head-case is rounded, depressed, black-dotted and with a black crescent over the eye. The wing-cases are lighter brown, with numerous roundish, black, irregularly spaced spots on the nervures and a cluster near the base. The leg-cases and tongue-case are also irregularly dotted with similar spots, while the antennæ-cases are without them. The segments are dark brown at the incisures and are covered with numerous small indentations, of which some are black — those of the last two segments more conspicuous. The first spiracle has a black spot posterior to it, while the others are surrounded by black. The terminal spine is one-tenth of an inch long, curved, smooth, shining black, and minutely bifid.

The Moth.

The moth appears abroad from the middle of June to August. Mr. Saunders, in his "Insects Injurious to Fruits," represents it as double-brooded, but it is doubtful if it is so at the north. For some reason the imago develops very unequally, for, from larvæ collected at the same time and with their pupation under identical

conditions, I have noted a difference of between three and four months in the time of the emergence of the moths — in one instance 104 days. But not infrequently, as occasionally in *Macrosila quinquemaculata* and other one-brooded *Sphingidæ*, some of the earliest larvæ complete their transformations during the same summer, and appear abroad on the wing, but at too late a season for a second brood of larvæ to mature and attain pupation. Thus Dr. Harris reports (*Entomological Correspondence*, page 283), that two matured larvæ taken by him on July thirty-first, entered the earth on August third, pupated on August sixth and seventh, and gave out the imago on August twenty-ninth.

Fig. 7.—The green grapevine moth, Darapsa Myron.

The moth is so well pictured in the figure that it need only be added that the head and thorax are olive-green; the abdomen of a dull green, shaded with reddish; the front-wings greenish-gray, banded and shaded with olive-green; the hind-wings rust-colored, with some green at the internal angle.

Remedy.

The caterpillars of this species have never proved so abundant but that their depredations could be controlled by picking them from the leaves upon which they are feeding and crushing them under foot. In addition to the grapevine, it feeds also on the Virginia creeper, *Ampelopsis quinquefolia.*

Alypia octomaculata and Eudryas grata.

The Eight-spotted Forester and *the Beautiful Woodnymph.*

(Ord. Lepidoptera: Fam. ?Zygænidæ.)

Sesia 8 maculata Fabricius: Spec. Ins., ii, 1781, p. 155, No. 8; Ent. Syst., iii, pt. i, 1793, p. 381, No. 8.*

Zygæna 8 maculata Fabricius: Mant. Ins., ii, 1787, p. 106, No. 51.

Sphinx octomaculata Smith-Abbot: Lep. Ins. Geo., i, 1797, p. 87, pl. 44.

Agarista octomaculata Latreille: Encyc. Method., ix, 1819, p. 803, No. 3.—Boisduval: Ann. Soc. Ent. Belg., xii, 1869, p. 68.—Melsheimer: in Harr. Entomolog. Corr., 1869, p. 116.

* The locality given by Fabricius for this insect, "India," would seem to be an erroneous one.

Alypia octomaculata Hübner: Zutr., 22, 1818, f. 119.—Harris: Entomolog. Corr., 1869, p. 285–6 (larva in different stages).—Stretch: Zyg.-Bomb. N. A., 1873, p. 6, pl. 1, f. 7.—Riley: 6th Rept. Ins. Mo., 1874, pp. 94–96, f. 25.—Saunders: Ins. Inj. Fruits, 1883, p. 262–3, f. 272.—Et al.

Bombyx grata Fabricius: Ent. Syst., iii, Pt. i, 1793, p. 457, No. 158.

Eudryas grata Boisduval: Spec. Gen. Lep., i, 1836, p. 14.—Harris: Ins. Inj. Veg., 1862, p. 427, pl. 6, f. 8.—Stretch: Zyg.-Bomb. N. A., 1873, p. 147, pl. 7, f. 1.—Riley: 6th Rept. Ins. Mo., 1874, pp. 88–90, figs. 22, 23.—Saunders: Ins. Inj. Fruits, 1883, pp. 258–261, figs. 268–270.—Et al.

The caterpillars of the two species of moths above named occur on the grapevine and Virginia creeper (*Ampelopsis quinquefolia*), and are often referred to, and have been frequently written of, as "the blue caterpillars of the vine." Although they bear so strong a resemblance to one another as not to be distinguished apart by the ordinary observer, and with difficulty by the entomologist,* yet the perfect insects differ almost as widely in their general appearance as it is possible for moths to do. It is often of much importance that the winged form of insects which are injurious in their larval stage should be generally known, in order that, when seen abroad, they may be recognized as the precursors of the injuries which are to follow in their train, and either be captured for destruction or driven away from the plants that they infest, or insecticidal application made that will arrest the career of their young as soon as they emerge from the egg. Such knowledge should be of particular service in preventing the attack of the eight-spotted Forester, which is often disastrous to the grapevine, and most annoying to one who has been watching and admiring the vigorous growth of the graceful Ampelopsis in its upward climb, and finds too late that further progress for the season has been arrested by the unnoticed eating away of almost every one of the most thrifty and tallest tips. Its moth is often to be seen as a conspicuous object from its peculiar coloring, flying at all hours of the day, unlike most of the moths, and hovering with a motion that attracts the eye, over the foliage upon which it alights from time to time to deposit an egg.

The Moths.

The figures given of the two moths will serve for their ready recognition if in connection therewith their marked colors are mentioned.

Both pairs of wings and the fringes of *Alypia octomaculata* are

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* In writing of *A. octomaculata* larva, Dr. Melsheimer has remarked: "It resembles the larva of *Eudryas grata* in its colorings and markings so much that before I was acquainted with its manners, I have frequently taken the one for the other, and was not aware of confounding them until the moths were disclosed." (*Harris Entomolog. Corr.*, 1869, p. 116.)

velvety-black; on the front pair, between the two spots before and below, and sometimes above the inner one and behind the outer, are lines or spots of violet-colored scales of a rich metallic lustre; the two spots of the front wings are pale yellow, and those of the hind pair, white. The thorax and abdomen are black, the former with a small yellow spot just behind the head, and yellow shoulder-covers shading paler toward their tip; the abdomen is marked with a small yellow tuft medially on its basal segment, and in the male with a few whitish hairs on the middle of each segment and a triangular-shaped white tuft on the segment before the last. The tibiæ (shanks) of the anterior and middle pairs of legs are clothed with long, deep orange-colored hairs. In the male, in front of the anterior legs, are two rather long, yellowish-white tufts.

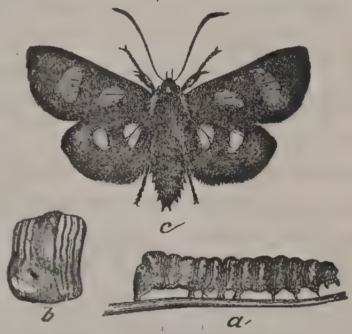

Fig. 8.—The eight-spotted Forester, Alypia octomaculata; *a*, the caterpillar; *b*, an enlarged segment of the same; *c*, the female moth.

In *Eudryas grata*, the anterior wings are pure white within. The stripe extending half-way across their front and the broad band crossing the outer margin are rusty-brown, bordered with olive-green; the band is traversed by waved lines of violet-colored scales of a metallic lustre; on the middle of the inner margin is a large triangular spot of olive-green. The posterior wings are dull yellow, with their hinder margin bordered with brown. The head is black. The thorax is crested with black, interspersed with pearl-colored scales; the shoulder-covers are white. The abdomen is yellow, with a row of black spots centrally and on its sides.

Fig. 9.—The beautiful woodnymph, Eudryas grata.

The Alypia Caterpillar.

The Alypia caterpillar has frequently proved a serious pest in certain parts of New York city in almost entirely stripping the grapevines of their leaves, and continuing the injury for several years in succession. In some localities — in Albany and elsewhere, it is becoming, or has already become, quite injurious to the *Ampelopsis* in eating off its terminal shoots and thus arresting its extension. It may be readily recognized from the representation given of it in Fig. 8, at *a* and *b*, and the following statement of its principal colorational features. The head is yellowish, with about eight black dots on each side. The

collar on the first segment is pale orange, dotted with black. The second and third segments have a transverse series of black dots, but without an orange band; the other segments have each a broad, central, orange band, with four narrow black bands on each side, counting those that border the orange. From each of the black dots shown in the enlargement, a long white hair is given out, which is longer than represented in the figure. Below the line of the stigmata (breathing-pores) is a series of white spots on segments four to nine, just behind the orange band; a large white spot rests on the incisure of the tenth and eleventh segments. The legs are orange at their base, and black externally and at their tip, except the anal pair, which are orange dotted with black.

The caterpillar may be found upon the Ampelopsis from the first of June until the first of August — its long continuance making it quite difficult to control its operations either by hand-picking or by insecticidal applications.

The Flight of Alypia.

The moth is a day-flier, and has, of late years, become very common in Washington park, Albany, where almost every year it may be seen flitting abundantly about the blossoms of *Deutzia gracilis*, upon which it delights to feed. Not unfrequently from ten to fifteen of the prettily and conspicuously marked creatures may be seen hovering over or momentarily alighting upon a single plant. It flies as early as 9 o'clock in the morning and continues until 6 P. M., or later. Commencing to appear as early as the middle of May, it remains until the middle of June. I have also observed it, in the same locality, flying abundantly, on May twenty-eighth, about the flowers of the bush-honeysuckle, *Diervilla Japonica.*

The Eudryas Caterpillar.

Both the caterpillar and the imago of *Eudryas grata* are rare; the former is so seldom met with that collectors experience difficulty in procuring specimens from which they may rear the beautiful moth for their cabinets. The caterpillar, *a*, in Fig.10, is characterized by *three* black bands on each side of the central orange band, instead of the *four* in *A. octomaculata;* an absence of the lateral series of white spots, and the presence of a prominent hump on the eleventh segment. Other features of it are shown in the figure, as also enlarged views of the egg from which it is developed.

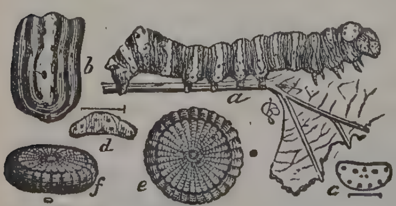

Fig. 10— Eudryas grata; *a*, the caterpillar in natural size; *b*, its fifth segment enlarged; *c*, its collar; *d*, markings of the hump on the eleventh segment; *e*, an upper view of the egg; and *f*, a side view, each enlarged from the natural size shown beside them.

Those who may desire further information of these two insects, and of two other species, of which the larvæ resemble them closely, are referred to an article in Professor Riley's sixth Missouri report, entitled "The Blue Caterpillars of the Vine," in which corrections are made of confounding of larvæ in preceding reports; and to one contained in my "Entomological Contributions, No. 3" (Twenty-sixth Annual Report on the New York State Museum of Natural History, 1874), entitled "On the Larva of Eudryas unio and Allied Forms."

Remedies.

Where the vines are not very large the conspicuously marked caterpillars of either of these two species can be easily discovered upon the leaves when they have attained a sufficient size to be of material damage. If those which can be reached from the ground or by the aid of a ladder, be gathered and destroyed the ravages will be greatly lessened. If the extent of the vine is too great for hand-picking, or the operation proves disagreeable from the green liquid that the Alypia caterpillar commonly ejects when handled, I would recommend, as the most economical and safest method of dealing with the caterpillars, showering while they are still young with hot water by means of a garden hose attached to the hot-water faucet of the kitchen, if accessible. The water, partly cooled by its passage through the air, will probably not retain sufficient heat to injure the plants, but quite enough to kill the caterpillars which it reaches, for as a rule the lepidopterous larvæ can not endure any great degree of heat. If insecticides need to be used, pyrethrum water or a kerosene emulsion would be efficient.

When nearly mature, numbers of the Alypia caterpillar can be made to drop to the ground if the vines that they infest be suddenly shaken or brushed, when they can be gathered and killed. Dropping them in a can containing a little kerosene is a convenient method of killing them, as well as all other hand-picked insects.

Phobetron pithecium (Sm.-Abb.).

The Hag-Moth Caterpillar.

(Ord. Lepidoptera: Fam. Bombycidæ.)

Phalæna pithecium Smith-Abbot: Nat. Hist. Lep. Ins. Geo., ii, 1797, p. 147, pl. 74.

Ecnomidea pithecium Duncan: in Nat. Lib.—Entomol., vii, 1841, pp. 183–186, pl. 21, f. 3 ♀, 4 larva.

Limacodes pithecium Harris: Rept. Ins. Mass., 1841, p. 304; Ins. New Eng., 1852, p. 324; Ins. Inj. Veg., 1862, p. 421, figs. 208, 209; Entomolog. Corr., 1869, p. 244–5.

Limacodes pithecium. Fitch: in Trans. N. Y. St. Agricul. Soc. for 1856, xvi, p. 381; 3d Rept. (3d–5th) Ins. N. Y., 1859, p. 63, No. 85.

Limacodes pithecium. Morris: Synop. Lep. N. A., 1862, p. 127.

Phobetrum pithecium Packard: in Proc. Ent. Soc. Phil., iii, 1864, p. 340; Guide Stud. Ins., 1869, p. 290; Ins. Inj. For.-Sh. Trees,—in Bull. No. 7, U. S. Ent. Commis., 1881, p. 47.

Limacodes pithicium. Riley: in Amer. Entomol., ii, 1870, pp. 25, 340, f. 209; 5th Rept. Ins. Mo., 1873, p. 126 (stinging power).

Phobetron pithecium. Lintner: Ent. Contrib. No. III — in 26th Rept. N. Y. St. Mus. Nat. Hist., 1874, p. 149 (on hazel); in Count. Gent., xlvii, 1882, p. 745 (general notice); id., liii, 1888, p. 725.

Phobetron pithecium. Saunders: Ins. Inj. Fruits, 1883, p. 112, f. 111 (habits, food-plants, etc.).

Phobetron pithecium. Dimmock, A. K.: in Psyche, 1885, p. 280 (bibliography).

Phobetron pithecium. Hubbard: Ins. Affect. Orange, 1885, p. 142–3, figs. 62–3.

Perhaps the strangest, queerest looking caterpillar that is to be found among all of the known Lepidoptera of the United States, is the one named above as "the hag-moth caterpillar," and (imperfectly) illustrated in Fig. 11. It never fails to enlist attention and excite curiosity when for the first time its motion attracting the eye shows it to be a living creature; but its wonderful mimicry of bits of dead and curled or eroded leaves is usually the cause of its being passed over without observation. Its peculiar shriveled appearance together with its dark color, is thought by Dr. Harris, to have suggested to Sir J. E. Smith, who first described it in the beautiful and costly volumes on the "Rarer Lepidopterous Insects of Georgia," the specific name of *pithecium*, the meaning of which is a shriveled and monkey-faced old woman. And from the same characters, undoubtedly, the common name that it bears of the hag-moth caterpillar has been drawn.

Description of the Caterpillar.

It belongs to a group of Bombycid caterpillars which, from their slug-like form and gliding motion, without apparent feet, are known as "slug caterpillars," and scientifically as *Cochlidiæ.* Indeed, some of the species, but for their bright and often varied colors and the broad spines that they bear, would naturally be mistaken for slugs. *Pithecium* is about an inch in length, apparently headless as seen from above, thick-bodied, of the form shown in the figure, of a dark brown color, and clothed with a velvet-like down over the low tubercles which the rings bear. Projecting from each side are four long, tapering, flattened, curling, velvety appendages, such as might suggest a miniature octopus. Of these, the pair near the front, on

Fig. 11.— The hag-moth caterpillar, Phobetron pithecium.

the middle and near the end, are nearly as long as the body, while the terminal pair are about one-third as long. There are also other shorter ones intermediate to these. These appendages* are strongly constricted at their base and so slightly attached to the body that they are easily broken off. They are always cast off, together with a number of other subtriangular smaller ones, before the construction of the cocoon, and ordinarily several of them will be found woven fast to the outside of the cocoon.

It is strange that while the peculiar and interesting larval form is not a rarity in some portions of the United States, no detailed description has been given of it from which the number, form and location of these appendages may be learned. The figures that we have do not supply the want; they disagree in structural features, and in one we are presented with thirteen distinct segments, exclusive of the head, with a probable fourteenth. Dr. Fitch states that "the sides of its body are prolonged in eleven, tooth-like processes." In the absence of specimens of the larva to compare with this representation, I will quote from notes made by me on two examples received by mail which were in the larval stage when sent. "The box contained two cocoons (the caterpillars having spun up en route) and fifteen of the velvety arms (some are frequently lost during growth). Besides these, there were also fifteen subtriangular velvety pieces which had been borne upon the more prominent lateral tubercles, of which there are probably four on each side."

Its Stinging Power.

The caterpillar is named by Riley in a list of thirteen, mostly *Cochlidiæ*, whose spines have an urticating power.† A few others possessing this power have since been added to the list, as exceptions to the rule that caterpillars may be handled with impunity and without fear of their stinging, biting, poisoning or inflicting any other harm, notwithstanding the strong jaws, liquid secretions, bristling spines, and formidable horns with which they are provided as if for both defense and offense. The almost universal fear or dislike of caterpillars is unreasonable — is not natural and would not prevail but for erroneous and culpable teaching in childhood. Careless habit, or undeveloped powers, of observation fail to note the jointed legs with which most caterpillars are provided, and they are therefore relegated to the class of creeping or crawling things — so closely

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*No suitable name has been found for them. Fitch designates them as "tooth-like processes;" Harris as "flattened teeth;" Hubbard as "fleshy hooks."

† *Fifth Report of the Insects of Missouri*, 1873, p. 126.

associated in many minds with snakes; hence, children in infancy are taught that everything that creeps must be avoided, and every snake, however beautiful, innocent, and in movement the embodiment of grace, must be killed. Such ignorance is to be deplored. It results in the overlooking of much that is worthy of admiration and study, tends to the development of cruelty towards the lower forms in nature, and is often the occasion of much unnecessary fear and alarm. For example: A newspaper account that obtained wide circulation not long ago, and was doubtless believed by many, made of one of our harmless caterpillars, the common tomato-worm (of which hundreds have been handled by me, without having experienced even the slightest nip from their jaws), a creature more venomous and more to be dreaded than the rattlesnake. If disturbed, it would inflict a mortal sting with the horn on its tail, and it was capable of ejecting a venom to a distance of several feet, which was certain death to whomever it struck.

I have no personal knowledge of the stinging power of the hag-moth caterpillar. It certainly can not exist to any great extent, for it is unprovided with such urticating spines as are found in *Lagoa crispata,* and are so conspicuous in *Hyperchiria Io* and *Hemileuca Maia.* I do not recall any spines or hairs that would serve the purpose, but Mr. Hubbard, who is more familiar with it, states that they occur among the feathery brown hairs with which the "fleshy hooks" (arms) are clothed, as longer, black, stinging hairs.

Miss Emily L. Morton, of New Windsor, N. Y., who probably has had more experience with the caterpillar than anyone else, has written in reply to inquiry made: "Although I have handled dozens of them every year, for some time past, in all stages and of all ages, I have never yet discovered any indications of a power to sting — such as is possessed by *Lagoa crispata* (in my experience the very worst of all stinging insects), *Empretia stimulea,* or even the somewhat painful though only momentary sting of *Euclea querceti* or *Parasa Chloris.*" The testimony of Mr. Herman Strecker is to the same effect; he has written of it: "This little worm has a Victor-Hugo devil-fish sort of look, but can not sting, and is perfectly harmless."

Its Degree of Abundance.

The caterpillar does not often come under notice of the field collector, and from the comparatively few examples of the moths that are to be found in our collections, it may properly be regarded as a rare insect in the northern States. Dr. Harris records an instance in which, on the testimony of an agricultural friend, "a swarm of these caterpillars appeared on a cherry tree and nearly stripped it of its

leaves," but as it is not stated that the caterpillar was identified by Dr. Harris, it is not at all improbable that some other larva may have been mistaken for it, although its remarkable appearance should prevent its being confounded with any other. Mr. Hubbard seems to have met with it in abundance in the orange groves of Florida and to have had favorable opportunities for observing its habits, for he informs us that he found it to display "the extreme of instinctive sagacity in a device to which it frequently resorts when unable to find a suitable place in which to weave its cocoon, in making itself more satisfactory surroundings by killing the leaves, upon which, after they have become dry, it places its cocoon." Mr. Hubbard states: "Several of these caterpillars unite together, and, selecting a long and vigorous immature shoot or leader of the orange tree, they kill it by cutting into its base until it wilts and bends over. The leaves, in drying, turn a light tan-color, which harmonize most perfectly with the hairy locks of the caterpillar covering the cocoon." The above notes of habit are apparently based on observations made upon numbers of the caterpillar, and would almost indicate a social disposition never observed in the northern States.

Food-plants of the Larva.

I have had the larva, on different occasions, feeding on the apple, crab-apple, and pear. One example was found by me, at Bath, near Albany, feeding on hazel, *Corylus Americana.* Dr. Harris states that it occurs on forest trees, cherry trees, and apple trees in New England, from July to September. According to Mrs. Dimmock, it is often found on the white birch, *Betula alba.* Abbott gives persimmon [*Diospyros Virginiana*] and the various kinds of oaks as its food. Other food-plants given for it are plum, wild cherry, white and red oak, and orange. To these, MS. notes of Miss Morton, kindly submitted to me, add, sugar-maple (*Acer saccharinum*), ash, witch-hazel (*Hamamelis Virginica*), and chestnut (*Castanea*). Larvæ had been reared by her from eggs found on chestnut and sugar-maple. Those from the former grew more rapidly and attained larger size.

The Cocoon.

This caterpillar shows a disposition to spin itself up in its cocoon at any time after its last molting, under the provocation of a temporary withdrawal from, or an imperfect condition of, its food, or possibly from confinement and exclusion from light. In almost every instance in which it has been sent to me by mail, it had either inclosed itself in its cocoon when received, or proceeded to do so the day

thereafter. This peculiarity has been noticed in *Aotias Luna* and others of our Bombycids, and in *Aglia tau* of Europe.* If shared by many of the *Cochlidiæ,* it may be the explanation of the failure that so generally attends the efforts to rear their larvæ to the imago stage.

The cocoon is oval and parchment-like, as are those of *Euclea, Empretia,* and *Limacodes,* which are more frequently met with. In nature, it is said to be formed usually between leaves. Confined in a box, it is quite as often attached to the sides as to the leaves that may be therein. The one fed by me on hazel spun its cocoon on the surface of some damp sand, fastened to the twig standing therein. The outside of the cocoon was covered with grains of sand, and in its upper portion were interwoven some of the long arms which have been described as characteristic of the larva. It was broadly oval, slightly flattened on the sides, measuring three-tenths of an inch by four-tenths, being about the form and size shown in the accompanying figure, although described by Mr. Hubbard as "almost spherical — bullet-shaped." Compared with *Empretia stimulea* Clemens, it is less elongated, for in that we have the proportion of 0.32 to 0.50 in.

Fig. 12.—Cocoon of the hag-moth caterpillar, Phobetron pithecium.

The attachment of several of the hairy arms of the caterpillar to its cocoon, which is usually a feature of it, is probably the result of the chance projection of the arms through the meshes of the frame-work of the cocoon, the difficulty of withdrawing them with the threads clasping their contracted base, and the ease with which they would be torn off in the contortions of the caterpillar in its close quarters, seemingly so disproportionate to its size. This dismemberment of its ornamental appendages, so often remarked upon by writers, would, therefore, appear to be involuntary and a necessity, rather than intentional, and for any purpose that it might serve in the economy of the insect.

The cocoon, in giving out its moth, opens by a circular lid in one end, made for the purpose by the larva during the construction of the cocoon. With no example at hand for examination, I am not able to state whether the lid displays even an approach to the remarkable ingenuity shown by the *Lagoa crispata* larva in the building up of the lid of its cocoon with hinge and an inner guard to protect from outward pressure.†

* *Entomological Contributions,* No. III — *Twenty-sixth Rept. N. Y. St. Mus. Nat Hist.,* 1874, p. 153.

† *Entomological Contributions,* No. II, 1872, p. 38 — *Twenty-fourth Rept. N. Y. St. Mus. Nat. Hist.,* 1872, p. 142.

Description of the Moth.

Female.— The front wings are narrower than in most of the *Cochlidiæ*, prolonged apically, and with rounded angles. They are yellowish-brown medially (nearly reaching to the costal margin), and outwardly forming a wavy band of five flexures which is bordered within by a similar band of a darker shade, and without by a narrow dark brown lunulated band which begins on the costa near its outer third, and following the curve of the wing approaches nearer the outer margin as it proceeds, is bent sharply inward beneath the cell, and thence descends in a perpendicular line to the inner margin. A similar toothed line crosses the wing just within its middle. (These lines have not been very well shown in the figure; they are not uniformly developed in all examples of the moth.) A large rounded, pale, yellowish-brown spot, which is darker within, rests on the inner margin beyond its middle. A dark brown shade-band runs near the outer margin. At the outer end of the cell is a small black spot. The basal portion of the wing is dark brown with some fuscous lines.

Fig. 13.—The female hag-moth, Phobetron pithecium.

The hind wings are somewhat broader than the front pair, pointed at the apex, and so short as not to reach the end of the abdomen. The fringes of both pairs of wings are spotted with dark brown. The legs are hairy and tufted; the tibiæ (shanks) of the middle pair bear a conspicuous tuft of long pale yellow hairs. Antennæ simple. Expanse of wings, about one inch.

Male.— The front wings are narrower than in the other sex and less rounded at the angles. The colors are similar but darker, limited almost to the inner margin, the rest being thinly-scaled or transparent. The hind wings with their acute angles are almost rhomboidal in shape; their anterior half is transparent. The antennæ are broadly bipectinated. The abdomen bears a terminal tuft of ochreous hairs. Expanse of wings about three-fourths of an inch.

Fig. 14.—The male hag-moth Phobetron pithecium.

The abdomen of my only example is apparently brown, but it is greased, and the entire moth is in too poor condition, from injuries incurred in its breeding-cage, for accurate description. Miss Morton, who has been favored with the privilege of seeing many of the males flying around the cage of confined females, describes the abdomen of the male as steel-blue, like that of the blue-bottle fly.

But Little Published of the Insect.

As almost nothing has been published on the history and habits of this interesting insect and knowing that Miss Morton had given particular attention to the *Cochlidiæ* and had been very successful in rearing them, I requested, if not desired for publication by herself, that she would permit me to introduce in the present notice, such notes as she might be able to give upon this insect. In response, she has very kindly communicated the following interesting and valuable contribution :

Life-history and Habits, as Observed by Miss Morton.

The egg.—"The eggs of the Limacodes bear no resemblance to any other species of Heterocera with which I am acquainted. Most of them would be invisible on a leaf as they are perfectly transparent. Even on white paper, the ova of *Parasa fraterna* are most difficult to find, and only by holding them against the light, a slight, shiny appearance is to be observed like a minute drop of dew.

"The eggs of *P. pithecium* are very flat, nearly an ellipse though slightly truncate at one end. When newly laid they are like tiny drops of transparent gelatine, of a pale brownish color, becoming darker with age and the development of the embryo larva. In ten days the eggs usually produce their larvæ, but if the nights are cool they develop more slowly, requiring twelve and sometimes fourteen days to reach maturity.

The larvæ.—"Of the young larvæ I know but little, as the only year in which I was successful in rearing them, I took no notes, and for the past three years, although the eggs developed, all of the larvæ died without emerging. From memory, those that I reared looked, on hatching, exactly like the mature larva in miniature, having the same brown cimeter-shaped processes covered with a soft fur-like clothing, but with the processes shorter in proportion to their size and less curved. They are of very slow growth, eggs hatching in the middle of July taking until the last of September and even into October before the larvæ made their cocoons. They did not fully mature until the nights became cold and the leaves changed on the chestnuts, which seemed to be their favorite food-plant.

The cocoon.—"The cocoon is of a dark chocolate-brown, with the usual 'lid' of all the Limacodes. The furry appendages of the larva are fastened to the outside of the cocoon, but adhere to it so slightly that they soon drop off unless handled very carefully.

The moth.—"In emerging, the moth leaves its transparent pupal-case projecting half-way from the cocoon. It seems to be very regular

in the season of its making its appearance from the pupa, for in three consecutive years it occurred on the third and fifth of July. The moths escape from the cocoons quite early in the morning. The males take wing and seek their mates from about 9.30 to 10.30 A. M. The mating ordinarily continues for three hours, although sometimes prolonged until the evening. The female begins to fly and deposit her eggs between 8.30 and 9 in the evening, placing them singly (in confinement), or more rarely in groups of four to eight. Abroad, seldom more than two eggs are placed on a leaf.

Habits of flight.—"*Pithecium* is the only Limacodes known to me which seeks its mate in broad daylight and bright sunshine. If the day is rainy the male will not fly. I do not know whether the great difference between the sexes has been noticed by observers, or the very strong resemblance that the male presents to a blue-bottle fly. When on the wing seeking its mate, its steel-blue abdomen and semi-transparent wings, together with the buzzing noise that it makes, would almost lead anyone to take it for a 'blue-bottle' unless acquainted with its habits. On warm and bright days the males will at times be seen swarming, to the number of fifteen or twenty, about the cage of a newly emerged female placed out of doors, coming suddenly, circling and buzzing around it, and as suddenly darting away with a swiftness that the eye can not follow."

To the above notes of Miss Morton, I would add: The eggs of *P. pithecium* (some of last year that failed to develop their larvæ were kindly sent to me) are the most remarkable looking objects of all the insect eggs that I have ever seen. Certainly no one unacquainted with them and meeting with them abroad, and not seeing them deposited by the moth (perhaps not even then) would suspect their nature. They are simply minute, flattened discs, showing no elevation as viewed from above, but only a slight circular depression within. When examined obliquely or against the light, the depressed line is seen to define the outline of the young larva curved so that the head and tail nearly touch, and occupying about one-half of the diameter of the egg. The greatest thickness of the egg is about one-half that of the thin sheet of paper to which they are attached. In size they hardly exceed an ordinary "fly-speck," measuring in the longest diameter 0.075 of an inch. Their color is a pale yellow-brown. Certainly, the egg is as peculiar, extraordinary, and as ludicrous as is the larva.

The statement of Miss Morton that the cocoons of *pithecium* are made the last of September or even in October is confirmatory of the

remarks made on page 188 on an apparent habit of the larva of inclosing itself in its cocoon prematurely, under certain conditions. Examples sent to me by mail, and, of course, subjected to unnatural treatment in their boxing, etc., have made their cocoons as early as in August. My notes — all the dates bearing on this point that I have — show the following, which will be seen to be quite in contrast with Miss Morton's experience with her carefully matured larvæ :

Larva, August 4, on pear; cocoon made August 6.
Larva, August 22, on apple; cocoon made August 24.
Larva, September 2, on hazel; cocoon made September 16.
Larva, September 3, on pear (fruit); cocoon made September 5.
Larva, September 4, on crab-apple; cocoon made September 7.
Larva, September 9, on pear; cocoon made September 12.

Parasites.

Miss Morton has sent me a Tachina fly which she has bred from *pithecium* which I can not separate from unnamed examples in my collection, marked " bred from Limacodes sp?" The slug caterpillars are apparently very liable to Tachina attack. Miss Morton feelingly remarks, in writing of the example sent: "It looks to me like all the grey Dipteræ infesting the Limacodes which so often render a summer's hard work abortive by their emergence from the empty skin of the mature larva just as it is about to form its cocoon."

Anisota senatoria (Sm.-Abb.).

The Yellow-striped Oak Caterpillar : The Senatorial Oak Moth.

(Ord. Lepidoptera: Fam. Bombycidæ.)

Smith-Abbot: Lepidop. Ins. Geo., ii, 1797, p. 113, pl. 57 (larva, pupa, ♂ & ♀ imago). As *Phalæna.*

Hübner: Verz. Schmett., 1816, p. 193, No. 1979 (as *Anisota*).

Harris: An.-Pl. Mass., 1835, p. 72; Rept. Ins. Mass., 1841, p. 292; Ins. New Eng., 1852, p. 312; Ins. Inj. Veg., 1862, p. 405–6, f. 198 (larva), 199 (pupa), 200 (♀ imago); Entomolog. Corr., 1869, p. 298, pl. 2, f. 9 (larva), pl. 4, f. 12 (pupa). As *Dryocampa.*

Walker: Cat. Lep. Brit. Mus., 1855, Pt. VI.

Fitch: 5th Rept. Ins. N. Y. (3d.–5th Repts.), 1859, p. 43.

Morris: Synop. Lep. N. Amer., 1862, p. 231.

Packard: in Proc. Ent. Soc. Phila., iii, 1864, p. 385; in Bull. No. 7, U. S. Ent. Comm., 1881, p. 45 (habits, etc.).

Grote: in Proc. Ent. Soc. Phila., iii, 1864, p. 93 (restores *Anisota* Hübner); in Proc. Amer. Philosoph. Soc., xiv, 1874, p. 260 (place in classif.).

Walsh: in Pract. Entomol., ii, 1866, p. 7 (in Wisconsin).

Glover: in Rept. Comm. Agricul. for 1870, p. 83, f. 43 (larva).

Boisduval: in Ann. Soc. Ent. Belg., xv, 1871–2, p. 87, pl. 3, f. 5 of larva (*Adolecephala*).
Lintner: Ent. Contrib., No. II, 1872, p. 51–2; and in 24th Rept. N. Y. St. Mus. N. H., 1872, p. 155–6 (larval notes).
Treat: in Amer. Agricul., xxxiii, 1874, p. 344 (habits).
French: in 7th Rept. Ins. Ill., 1878, p. 196 (brief description); in 10th Rept. do., 1881, p. 120 (larva described).
Coquillett: in 10th Rept. Ins. Ill., 1881, p. 161 (larva described).
Clarkson: in Papilio, ii, 1882, p. 188 (abundance in Columbia Co.).
Claypole: in Canad. Entomol., xv, 1883, p. 36 (abundance in Penn.).
Dimmock, A. K.: in Psyche, iv, 1885, p. 275 (bibliography and food-plants).

The caterpillar of this species, although it may not claim high rank in a list of our insect enemies as the cause of serious harm and pecuniary loss, yet, it at times presents itself to our notice in such vast numbers, and its defoliation of the trees that it infests is so marked and startling, that it is not strange that fears are ofttimes entertained lest its ravages should extend to other vegetation which would at once transform it into a formidable pest. To meet the inquiries that are from time to time made of its habits, and the information that is desired of it, the following somewhat extended account has been prepared, from notes made several years ago and from published notices in scattered works, many of which are named in the bibliography above given.

The Egg-laying.

The large and conspicuous moth, which will be noticed hereafter, was observed by me at Center, N. Y. (now Karner), July 7, 1869, depositing its eggs on the under surface of oak leaves, distributing them over the surface in large patches, in a single layer, in close contact with one another. A leaf of *Quercus prinoides* of ordinary size was plucked, which had one-half of its surface covered with the eggs. From a count of a portion of the deposit, and an estimate of the remainder, the number of eggs was 500. This may be accepted as the ordinary number from a single moth — usually placed in separate patches on a leaf, or on two or more leaves.

The female, doubtless, oviposits soon after emerging from the pupa. Her abdomen is so greatly distended with her burden of eggs that she is unfitted for flight and almost helpless. On one occasion my attention was drawn to some commotion in the sand of a roadway at Center, not recognized at the distance, when, on approaching nearer, it was seen to be a female *senatoria*, which was being knocked and rolled helplessly and ludicrously about in the ardor with which a half-dozen males flying above and around her were striving for her possession.

Larval Stages.*

First stage.—Larvæ from eggs collected on July seventh hatched on the eleventh. The head of the newly-hatched larva, after assuming its proper color, is glossy black and of an oval form. The body is pale yellow-green, with a few short hairs; on the second segment are two smooth, straight, subcylindrical, black horns, arising from a green base, and with a slight enlargement at their apex, where they give out two black diverging setæ of the length of two-thirds that of the horn.

The young larvæ feed in company, and occupy both surfaces of the leaf, the entire substance of which they consume, except the veins and veinlets, leaving frequently a very good skeleton of the leaf.

The *first molting* occurred on the eighteenth and nineteenth of July At this stage the body is obscure green with seven fuscous lines, of which the dorsal and stigmatal ones are narrow; the subdorsal and lateral ones broader, having in them a row of short spines. The collar (on first segment) centrally and the anal segment shining black. Legs black; prolegs with a black spot outwardly.

Second molt.— July twenty-eighth and twenty-ninth. Length of larva, 0.37 of an inch. Head and collar glossy black. Horns slightly spinose, enlarged at the tip, and usually with apical spines. The abdominal stripes are black, with yellow-brown intermediately, showing a broad stigmatal stripe. The terminal segment is spinose and glossy black.

Third Molt.— August fourth and fifth. Length, 0.60 of an inch. The larva is glossy black, with eight yellow stripes, of which the lower one is geminated by a crescent on the central portion of each segment inclosing a spinule; ventrally, from the fifth segment, is a yellow-green interrupted stripe. The horns are slightly tapering, clubbed at their tips, a d 0.20 of an inch long. The legs and prolegs are black.

Fourth Molt.— Extending from August fourteenth to sixteenth. Immediately following the molting, the head, collar, horns, anal shield and plates, and legs, are flavescent; in a few hours they became shining black. The horns are but slightly enlarged at their tip, being less so than previous to this molt. The body is covered with numerous shining, minute, elevated points of the color of the ground on which they are placed.

* From my *Entomological Contributions*, No. II (*loc. cit.*), of which a few copies only were published.

The Mature Caterpillar.

The larva when full-grown is two inches long and about the thickness of a lead pencil, cylindric, and of a coal-black color in stripes alternating with orange-yellow, as follows: Along the middle of the back is a black stripe, with a yellow one of the same width on each side of it. Outside of these is a broader black stripe followed by a yellow one on each side of the back, slightly broader than the two middle ones. Below these is another black stripe still wider than the one above, and below this along the sides are two yellow stripes with a black one between them in which the breathing-pores are placed. The upper of these last two yellow stripes is somewhat wavy and less smooth than those on the back, and the lower one is often widened on the fore part of each segment, or sends off a branch downward and backward [not shown in the figure]. Below this is an oblong yellow spot on each segment, which is sometimes lengthened to unite its anterior end to the yellow stripe. The under side is black with a yellow stripe along the middle, which is more or less interrupted. The legs and prolegs are black. The yellow stripes are not prolonged on the posterior and two anterior rings, but are here often replaced by small yellow spots. The head is black. The skin is tough and leathery, with numerous small, elevated, smooth grains, of which two on the fore part of each segment, placed in the yellow stripes, are larger and are sometimes elevated into small prickle-like points, and two others, similar to these, also occur posteriorly on each segment, but placed further apart. In addition to these, there are six larger, black, shining, conical prickles in a transverse row around the middle of each ring, some of which are occasionally forked at their tips into two sharp points. On the second ring in place of the two upper prickles, are two black curved cylindrical horns, equaling two of the rings in length and usually standing obliquely upwards and forwards, their tips blunt and shining. The last segment is rough from several prickle-like points of different sizes. (Fitch, in *Fifth Report Insects of New York*, [third to fifth reports] p. 43–44.)

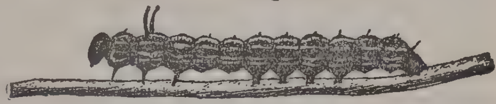

Fig. 15.—The yellow-striped oak caterpillar, Anisota senatoria.

Abundance of the Caterpillar in New York.

Dr. Fitch, writing of it, states: "The latter part of August, 1858, I observed them in greater numbers than I had ever before seen, in the cemetery at Saratoga Springs, where they had stripped most of the oaks of their leaves, and were then descended from the trees, probably in search of food elsewhere, as few of them appeared to be grown to their full size. They were everywhere crawling sluggishly about upon the surface of the dry, sandy soil, and up the sides of the monuments. In the paths, the dresses of the ladies sweeping over them, these worms frequently adhered to and crawled up them, to the great annoyance of everyone and the alarm of the more timorous."

In former years, they were found annually in great abundance at Center, N. Y. This locality was their metropolis until within a few years past, since which time the fires that have repeatedly swept over it have banished the superabundance of insect life that for so long a time made it perhaps the most noted insect hunting-ground of the northern United States. In the more favorable years for its multiplication, it abounded so excessively that all of the smaller oaks which were so numerous there, occurring in extended areas to the exclusion of other shrubs or trees, were, during the month of August, as effectually defoliated as if they had been swept by fire.

Dr. James Eights, a distinguished naturalist, for many years a resident of Albany, has informed me that on one occasion he observed on the line of the railroad between Albany and Schenectady, a species of caterpillar so exceedingly abundant on and about the railroad track, that the numbers crushed by the passage of the trains caused the slipping of the wheels of the engines to such an extent as to necessitate the sanding of the rails before the train could proceed. A notice of the interesting incident was communicated by him to one of the journals of the day, in which some account of the caterpillar was given Although, from the number of years that had elapsed since the event he was not able to indicate positively the species, he believed it to have been *A. senatoria*, and the locality of its occurrence, in the vicinity of Center.

Mr. F. Clarkson has recorded (*loc. cit.*) a remarkable prevalence of the caterpillar at Livingston, Columbia county, N. Y., in the year 1882. It appeared in the latter part of June, and before the middle of August the larvæ had consumed all the leaves of the young oaks, and had visited many of the older trees standing in lawns and on the borders of forests.

Elsewhere than in New York, it has been reported as fearfully numerous along the Michigan Central railroad. "For three years the oaks near Kalamazoo have been entirely denuded of their leaves, and nearly all the trees first attacked have died." (*Report of the Commissioner of Agriculture* for 1869, p. 536.)

At New Bloomfield, Pennsylvania, in 1882, according to Prof. Claypole (*loc. cit.*), great ravages were wrought by it in the forests. He states: "I have seen hillsides that looked as if fire had passed over them, in consequence of the destruction of the foliage by millions of the species. In the woods they could be found crawling over almost every square foot of ground, and lying dead by dozens in every pool of water. The sound of their falling frass was like a slight shower of rain. Farmers tell me that they had never known them so abundant before within their recollection."

Its Food-plants.

The caterpillar was believed to feed exclusively on the different species of oak, until recently, when Mrs. A. K. Dimmock, of Cambridge, Mass., has added white birch (*Betula alba)* to its short list of food-plants. To what extent it was observed to feed thereon is not stated (see *loc. cit.*). Messrs. Walsh-Riley have recorded an instance in which the eggs of the moth were laid on raspberry leaves (*Amer. Entomol.*, ii, 1869, p. 26), but it was probably under the constraint of inability to reach an oak for oviposition, and it is doubtful if the larvæ when hatched would have fed on the raspberry.

Dr. Harris states that in Massachusetts they live on the white and red oaks [*Quercus alba* and *Q. rubra*]. Professor Claypole observed the white oak to be untouched by them at New Bloomfield, Pa., and their food to be almost exclusively the foliage of the black-oak (*Quercus tinctoria*), the scarlet-oak (*Q. coccinea*), and the bear or scrub-oak (*Q. ilicifolia*). In my own observations at Center, they have usually occurred on the dwarf chestnut-oak (*Q. prinoides*) and on the black scrub-oak (*Q. ilicifolia*).

Its Distribution.

Although originally described from specimens collected in Georgia, it is far less abundant in the southern States than in the northern.* Its eastern range is apparently from Canada to Georgia. To the westward it is reported in published lists from Wisconsin (Walsh), Missouri (Riley), Kansas (rare, Snow), and California.

It seems to be rather a local insect. Dr. Fitch mentions the fact that he had never met with it at Salem, Washington county, where he resided, while it was very abundant only twenty-five miles distant. In my collections, extending over many years, it has never been seen by me in abundance in any other locality than at Center.

Stinging Powers.

This caterpillar is another of the few that are capable of inflicting a sting when handled. It is not as severe, however, as those of the *Cochlidiæ.* According to Dr. Fitch, its prickles, if they happen to penetrate the skin, produce a stinging sensation like that of nettles and a slight redness of the spot; both these symptoms, however, lasting but a short time, as in the case of nettle stings.

It is not included in the list of stinging larva by Prof. Riley, referred to on page 185, although mention is there made of the sting of *Anisota stigma,* on the authority of Dr. Fitch.

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*Prof. Geo. F. Atkinson, entomologist of the South Carolina Agricultural Experiment Station, at Columbia, represents this species as by far the most common Anisota in middle North Carolina. *A. rubicunda* is there frequently met with in broods on the maple, and twice he had found broods of *A. stigma* (Bull. No. 4, Jan., 1889, *So. Car. Agr. Exper. St.*, pp. 87-8.)

I have no recollection of having felt the sting of either this species or *Dryocampa rubicunda.* With the other Anisotas I am not familiar, they being rare in the State of New York.

Natural Enemies.

As would seem to be indicated by the remarkable number in which this insect often occurs, its known enemies are but few. Its formidable spines doubtless serve to protect it from destruction by insectivorous birds, although Professor A. J. Cook names two species that are known to eat it, viz., the robin and the blue jay [*Merula migratoria* and *Cyanocitta cristata*]. (*American Naturalist,* viii., 1874, p. 368.)

Of insect parasites, I only find recorded, *Limneria fugitiva* Say — a common parasite of the *Bombycidæ.* In its parasitism of the young larva of *senatoria,* in making its cocoon it uses the body-wall of its host, which it eats through and fastens to a twig of the tree on which the larvæ are feeding (Atkinson). From some of the parasitized larvæ, Professor Atkinson had obtained examples of a species of *Hemiteles,* but he could not determine whether it was a primary parasite on *A. senatoria* or a secondary one on *Limneria fugitiva.*

Another ichneumon parasite, reared from the caterpillar, is in my collection, undetermined, but unfortunately can not be found at the present for identification.

Description of the Moth.

The female has the thorax, abdomen, and wings of a bright ochreous-yellow color. Its front wings are freckled with blackish dots; a large white spot rests on the lower part of the cross-vein of the cell near the upper middle of the wing; and a faint purplish stripe runs, slightly waved, from just before the apex to the outer third of the inner margin. The hind wings are much smaller, angulated apically, a brighter ochreous toward their hind margin, and a straight purplish band traversing them behind their middle. Its antennæ are short and simple. Expanse of wings about two and one-half inches.

The male is much smaller in size, being about one inch and a half in spread. It is of a darker color; its front wings are triangular, feebly dotted with black, the white spot quite distinct, the purple traversing line inconspicuous especially toward its middle, where the wing is somewhat translucent. The hind wings are rhomboidal, with the purple line only indicated. The antennæ are broadly pectinated for more than one-half their length.

Summary of Life-history.

The moth may appear abroad in the State of New York for oviposition as early as the second week in June. On June sixteenth I have seen examples *in coitu* and females depositing their eggs.

The eggs hatch in from a week to ten days. The young caterpillars feed together in swarms, and, according to Harris, "have their regular times for eating and for rest, and when they have finished their meals they cluster closely together along the twigs and branches; if disturbed they raise the forepart of their body and shake the head to signify their displeasure." They undergo four moltings, and their five stages seem to average about nine days each.

During the latter part of July and in August the defoliation of the oaks that they cause is noticed. An oviposition extending over three or four weeks will naturally give varied degrees of growth of the larvæ met with abroad. Thus, notes made by me in 1869 show on August twentieth, larvæ quite small, some passing through their fourth molt, and others in their last stage; August twenty-seventh, full-grown larvæ; September eighth, matured larvæ on their travels prior to pupation; September fourteenth, still abundant; thirtieth, a few seen; the locality was not visited in October.

The larger number probably enter the ground for pupation during the second and third weeks of September. They bury to a depth of three or four inches, where they shape a small and simple cell in which to undergo their change to pupæ.*

When the time for the last stage in the series of transformations has arrived, the pupa, aided by the circlet of spines or teeth with which the front of each of its free-moving segments is provided, and by a strong bifid anal spine, forces itself to the surface and partly out of the ground, where it is held while the moth bursts its case and emerges. The females are at once attended by the males that have preceded and are awaiting them, and the pairing usually occurs in the grass beneath the oaks, according to Mr. Clarkson, before there is time to ascend the trunks. Soon thereafter the eggs are laid, as before described, on the lower surface of the leaves of the terminal twigs of the branches nearest the ground, seldom exceeding an elevation of ten or twelve feet.

Associated Species.

The two other species of Anisota, viz., *stigma* Fabr. and *pellucida* Sm.-Abb.,† also feed on the oaks, but they never occur in injurious num-

* It is of interest in this connection to mention that *Anisota Heiligbrodti* Harvey (*Canad. Entomol.*, ix, 1877, p. 110), since referred, by Grote, with *bicolor* Harris, *bisecta* Lintn., etc., to the genus *Sphingicampa*, has a pupation above ground in a double cocoon like that of *Cecropia* and *Promethea*, but net-like instead of solid, and attached to the mesquite (*Entomologica Americana*, i, 1885, p. 60).

† Mr. Grote, in his last Check List, and in a list of *Ceratocampadæ*, etc., published in 1874, has cited *pellucida* as a synonym of *Virginiensis* of Drury. I do not know why this reference was made, and believe that it has not been accepted by those entomologists, at least, who are unwilling to abandon a name, particularly when expressive and characteristic, as in this instance, which has been in general use for more than a century, unless the necessity for so doing is clear and unquestionable, and not simply resting on probabilities.

bers. *Dryocampa rubicunda* (Fabr.), often cited as *Anisota*, although having some other food-plants, is usually found on the maples (*Acer dasycarpum* and *A. saccharinum*), which it occasionally despoils of nearly all their foliage, particularly in some of the western States. It will, however, in confinement feed on oak leaves.

Remedies.

It will not often be necessary to resort to means for protection from the injuries of this insect, as the oaks that they feed upon in preference, and on which they occur in the largest numbers, are those that ordinarily occupy sandy tracts (as at Karner, N. Y.) or other unproductive places. When, however, their attack is made upon oaks that are valued for ornament or shade, it may be arrested by spraying the foliage with London purple in water.

Mr. Clarkson believes that its multiplication may be restrained by destroying the moths on their first appearance while among the grass beneath the oaks where their larvæ abounded the preceding year, and by trimming off the lower branches of the trees so that the foliage can not be easily reached by the heavy-bodied females, for oviposition.

Another remedy that has been recommended, for a similar larval attack, is to dig a trench, around an infested tree, of about a foot in depth, with its outer wall sloping inward, into which the caterpillars as they leave the tree for pupation will collect, and where they can be conveniently destroyed by crushing or by sprinkling with kerosene. A trench with the two walls sloping upward toward one another would be a still more effectual trap.

Agrotis saucia (Hübner).

Larva: *The Variegated Cut-worm.* Moth: *The Unarmed Rustic.*

(Ord. Lepidoptera: Fam. Noctuidæ.)

Hübner: Samml. Europ. Schmett., 1796, 378 (*Noctua*); Verzeich. Bek. Schmett., 1816, 227 (*Peridroma*).

Treitschke: Schmett. Eur., v., 1825, p. 149 (*Agrotis*).

Harris: Ins. New Engl., 1852, p. 344 (moth described); Ins. Inj. Veg., 1862, p. 444 (*A. inermis*).

Guenée: Spec. Gen. Lep.—Noct., i, 1852, p. 271 (remarks on larva).

Stainton: Man. Brit. Moths, i, 1857, p. 224 (brief descriptions of moth and larva).

Boisduval: in Ann. Soc. Ent. France, ser. 3, vii, 1859, Bull., p. 102 (ravages in tobacco plantations in Algiers).

Riley: 1st Ann. Rept. Ins. Mo., 1869, pp. 72-74, pl. 1, figs. 1-4 (descriptions and life-history, as *A. inermis*); 3d id., 1871, p. 129 (parasite from); in Rept. Comm. Agricul. for 1884, p. 297-8, pl. 3, figs. 1, 2 (notes on eggs and larva).

Speyer: Europ.-amer. Verwantschaften, in Stett. Ent. Zeit., 1870, p. 107; id., 1875, p. 134.

Grote: List. Noct. N. A., in Bull. Buff. Soc. Nat. Hist., i, 1873, p. 135 (identical with *A. inermis* Harris); id., ii, 1874, p. 11; id., 1875, pp. 308, 314; in 6th Rept. Peab. Acad. Sci., 1874, p. 22 (Eur. and Amer.); in Bull. G.-G. Surv. Terr., vi, No. 1, 1881, p. 163.

Morrison: in Proc. Bost. Soc. Nat. Hist., xvii, 1875 (in Texas, and identical with *A. Ortonii* Pack.).

French: in Trans. Ill. Hort. Soc., xi, 1877, pp. 192–194 (habits, etc.); in 7th Rept. Ins. Ill., 1878, pp. 94–5, 211–213 (description, habits, food-plants, etc.).

Lintner: Ent. Contrib., IV (in 30th Rept. N. Y. St. Mus. Nat. Hist.), 1878, p. 45 (dates of collection), p. 53 (in Patagonia); in 44th Rept. N. Y. St. Agr. Soc. for 1884, pp. 62, 63, 64 (food-plants), 68; in 39th Ann. Rept. [N. Y.] St. Mus. Nat. Hist., 1886, pp. 94, 95; in Trans. N. Y. St. Agricul. Soc. for 1888, pp. 71, 74, 75, 79, 85; Bull. N. Y. St. Mus. Nat. Hist., No. 6, 1888, pp. 8, 11, 12, 16, 22, figs. 11, 21.

Marten: in 10th Rept. Ins. Ill., 1881, p. 134 (description and habits of larva).

From Mr. P. Barry, of the Mount Hope Nurseries at Rochester, N. Y., some apple twigs, containing an egg-deposit from which the larvæ were emerging, were received on May seventh. The eggs had been sent to him for name, from Centralia, Kansas.

The Eggs.

The twigs were quite small, not exceeding one-sixth of an inch in diameter. The eggs were closely and symmetrically arranged, in a single layer, in regular rows joined to one another, forming an unbroken patch. In one example there were seven rows of about sixty eggs in each, extending over about an inch and a half of the twig. The eggs, upon the point of hatching, were of a lavender color. They were round, with about forty sharp and prominent longitudinal ribs, which were connected somewhat irregularly with numerous transverse lines. In Figure 16, at *a*, one is shown in enlargement, and at *b*, a twig with one of the egg-deposits is represented.

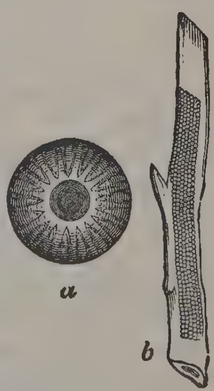

Fig. 16.— *a*, an egg of Agrotis saucia greatly enlarged; *b*, eggs of the same deposited upon a twig, natural size.

Desiring to learn more of the occurrence of the eggs, I addressed a request for the information to Mr. A. Oberndorf, Jr., of Centralia, Kansas, from whom the eggs had been sent to Mr. Barry. The following communication was sent in reply, under date of May twentieth:

Up to the seventeenth inst. I have found the eggs on the *twigs* and *bodies* and *branches* of young apple, pear, and peach trees, but

have found none on old or bearing trees. I found the eggs in batches, on twigs, in narrow strips from one inch to three inches long, and about three-sixteenths of an inch broad; on branches, in broader strips from one inch to two and one-half inches long and from one-fourth to three-eighths of an inch broad; on the bodies of trees, usually about in this shape and size,* and the eggs as close together as possible. I destroyed every nest that I could find, but concluded last Sunday to leave two nests in a little tree to see what they would do after being hatched. On Monday one-half of the cluster had changed from a light tan to a slate color, and yesterday evening that portion had hatched, and a number of little caterpillars, about one-eighth of an inch long, were wriggling about, but were gradually being carried away by the wind.

Larval Transformations and Habits.

First stage.— Some of the eggs had hatched when received from Mr. Barry, and the caterpillars presented the following appearance:

The head was black, the body green with indistinct lines, and a few scattered hairs. They had but three pairs of prolegs, and consequently looped in walking, after the manner of the *Geometridæ.* In dropping from the twig, they hung suspended by a thread that they gave forth. When disturbed they would often twist the head and several segments over the back, holding to the surface upon which they rested by the last two pairs of prolegs.

Grass was offered them of which they readily ate and with apparent relish. Some tips of apple twigs being given them, a few fed sparingly thereon, eating small holes into one surface of the unfolding leaves, but much the larger portion continued their feeding upon the grass.

Second stage.— Upon the fourteenth of May some of the caterpillars were observed to have undergone their first molting, and to have acquired in the operation an additional pair of prolegs. They were cylindrical, of a length of 0.2 inch, the head somewhat cordate with black setiferous spots; body with a pale dorsal line, two similar lateral ones, and a broad stigmatal stripe; the anterior pair of trapezoidal spots are black, elevated, and bear, as do the other setiferous spots, a stout black hair. The hinder part of the body slopes downward to the anal prolegs. There are now four pairs of prolegs.

Third stage.— Several of the larvæ had undergone their second molting on the morning of May eighteenth. They had now five pairs of prolegs (the normal number belonging to the *Noctuidæ*), and presented the following features:

Head dull yellowish, pale on the side, mottled, with two broad fuscous lines in front running from the summit of the head to the

* Referring to a rectangular figure given of about one inch by three-fourths, not continuously straight-lined on one of its longer sides.

palpi, curving toward one another and connecting mesially like an)((see this feature represented in the adult head at *b*, in Figure 17); last joint of the palpi black. Body cylindrical, bearing short black hairs on the setiferous spots, brown, shading darker toward the broad substigmatal yellow-brown stripe, a subdorsal black line shaded with yellow beneath, and a yellowish dorsal line accentuated into yellow spots on the summit of each segment, especially upon the third, fourth, fifth, and sixth (not counting the head as one); on top of the eleventh segment, a v-shaped black patch; beneath pale brown with delicate mottlings. Prolegs pale, semitranslucent. The setiferous spots are elevated and shining black. The larval length at about the end of this stage, is 0.55 inch.

The distinctive markings of this stage, are the pale lateral stripe, the fuscous dorsum (paler in many examples) and the dorsal line of yellow markings — the anterior ones of which are either rounded or lozenge-shaped and the following ones becoming elongated into lines.

During this stage and onward to maturity, the brood was fed on plantain leaves (*Plantago major*), for which they manifested a great fondness. They were not easily disturbed in their feeding when brought under observation. When removed by hand to fresh leaves they simply curled up in the usual cut-worm manner, without showing any alarm.

Fourth stage.— The third molting commenced on May twenty-first, and was completed in about two days. Their length at the end of the stage was 0.8 inch. The lines of the head are shining black, broader comparatively than before, and yellowish on the sides. Body, general coloring as before; about six conspicuous yellow dorsal spots, a black subdorsal line somewhat broken, with yellow beneath; resting on the line of the spiracles, a broad black band broken into crescents having the spiracles in one tip. The stripe beneath this is greenish with yellowish dots and beneath this, over the legs, greenish with whitish dots; a triangular black spot on the top of the eleventh segment and a yellowish patch behind it.

Fifth stage.— The fourth and last larval molt commenced on the twenty-fifth of May and was completed by the brood, 150 in number, on the twenty-eighth. Of larvæ fully matured on the thirtieth, the following are the prominent features:

Maximum length, 1.6 inch; average length of six examples, 1.46 inch, breadth, 0.25 inch. Colors not so bright or so contrasting as in previous stages — the prevailing shade being a sordid brown. The conspicuous features are: The yellow dorsal spots on the hinder part of segments two to seven inclusive, consisting of three or four trans-

verse markings on the obscure annulets; the dorsal black patch on the eleventh segment; an interrupted subdorsal black line consisting of a black streak on the posterior half of each segment; the stigmatal line of black crescents and the substigmatal line of a yellowish, approaching orange, color. The spiracles are small and black. One of the paler colored larvæ is represented at *a* in Figure 17.

At maturity.— By the thirtieth of May, many of the larvæ had ceased feeding and had evidently matured. The following day they were transferred to a box of earth upon which a layer of plantain leaves had been placed. When examination was next made on the third of June, a little feeding had been done. Four-fifths of the larvæ were found above ground, and the rest had buried themselves at different depths — some just beneath the surface, showing a slight contraction in length, indicating progress toward pupation. A few that had been transferred to a separate box with food, were still feeding on June fourth.

The Pupa.— On the fifth of June, three newly-disclosed pupæ were found beneath leaves on the surface of the ground — at first of a dull pale yellowish color, but later becoming mahogany-brown. The anterior segments following the rounded head-parts are cylindrical for the extent of the wing-covers, while the remaining six free segments rapidly diminish in size to the anal tip, which is armed with a single short, black, curved spine. The anterior margin of the segments is brown and closely punctated. Length, 0.7 inch; greatest breadth, 0.2 inch.

The Moth.— The first moths — eight in number — emerged from their pupæ on the twenty-fourth of June, and on the following day eighteen others made their appearance. The duration of their pupal stage would thence have been twenty days, and their larval stage twenty-eight days. The last of the moths, 150 in all, were given out on June thirtieth. The species proved to be very easy to rear, unlike most of the cut-worms — hardly any fatality attending any of the several transformations. The moths displayed a remarkable absence of timidity on being disturbed. With hardly any motion beyond the necessary readjustment of their legs, they could be lifted from the ground upon which they rested

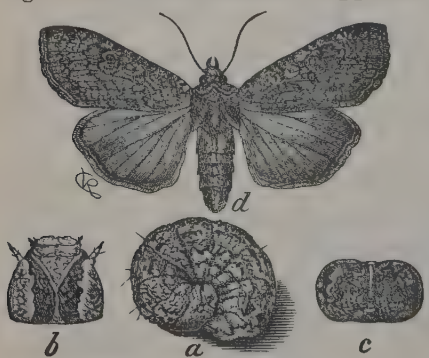

Fig. 17.— Agrotis saucia — *a*, larva; *b* and *c*, head and a middle joint of the same enlarged; *d*, the moth.

or from the sides of the box to which they were attached, by slipping a piece of paper underneath them, from which they could be quietly dropped in the cyanide bottle. If alarmed, they attempted escape by running rather than flight.

The form, size and general appearance of the moth are shown in Figure 17. Its general ground color is a uniform brownish-gray, but individuals differ greatly in color, a large number being found having the costal region of the forewings nearly black while the rest of the wing is yellowish-brown. Others have the front of the wings blackish, gradually shading into the usual brownish-gray. A variety is mentioned by Riley in which the costal region is of a dull golden-buff color, but this does not appear in the large brood reared by me, nor have I met with it in ample collections of the species abroad.

An Injurious Species.

The variegated cut-worm is regarded as one of the most injurious of its class, from its numbers, its great voracity and the broad range of its food. It apparently will attack almost any field-crop that it may find convenient for its operations, and when these are not at hand, it as readily feeds on grasses and weeds. In cold-frames, it has been quite destructive to lettuce. In conservatories it has been very injurious to smilax, *Myrsiphyllum asparagoides*, eating off the softer parts and especially the tops of the plants. In its attack on cabbage, it has imitated the habits of some of the boring species, by penetrating directly into the head. In Kansas, in 1885, it was very injurious to clover and timothy in Johnson, Meade and Douglass counties — in the latter stripping off the leaves of the clover and cutting off the heads of timothy early in June (Professor Snow, in *Rept. Kansas St. Bd. of Agriculture* for June 1885, p. 6).

Its Food-plants.

In confinement it has been fed on knot grass, corn, leaves of peach, apple, strawberry, willow, eupatorium, tips of grapevine, plantain, etc. Kaltenbach states that in Europe it feeds on *Stellaria* [chickweed], *Litorella*, *Plantago* [plantain], and *Rumex* [dock, sorrel]. Rouast credits it with feeding on roots of grains, under the lucernes and trefoils, *Centranthus ruber*, *Plantago*, *Rumex*, *Daucus* [carrot], and *Carduus*. He quotes Milliere as saying that it does not eat roots but only leaves.

A Double-brooded Species.

Professor Riley remarks (p. 298 of *Rept. Comm. Agricul.* for 1884) that his St. Louis notes (given) of eggs of the species hatched from April ninth to May twenty-fourth, and moths emerged from June fifth to July fifth, "indicate at least two annual generations, with a possibility of three." In my collections at sugar, at Schenectady, N. Y., in

1875, the first brood had entirely disappeared at my commencement on July second. The first individual of the second brood was taken on September seventh, and others following on the ninth, eleventh, thirteenth, fifteenth, twentieth, twenty-ninth, thirtieth, October second, fourth, tenth, nineteenth, and twenty-second — on each evening except seven, when the collections were made (*Entomolog. Contrib.*, IV, p. 45). The following year, 1876, the first brood was evidently delayed in the time of its appearance, as it was taken only between July eighteenth and August third. No collections at sugar were made during the autumn, and I have, therefore, no record of the appearance of the second brood of that year.

Its Geographical Distribution.

It is a species of very broad distribution, being found throughout most of Europe; in Canada and British Columbia; in the United States from the Atlantic to the Pacific; in South America, in Colombia, Brazil and Patagonia; and in the Madeira and Teneriffe islands.

Remedies.

The remedies for attack of this species of cut-worm, as indicated by what has been above given of its life-history and habits, should be, in general, such as give best promise of killing the larvæ when concealed during the day under leaves, or just beneath the surface of the ground when no better shelter is offered. Large numbers may be easily destroyed by poisoning them with prepared baits of their favorite foods when they come abroad to feed at night during the month of May, and crushing the pupæ by thorough plowing while buried at a moderate depth in the ground during late May or early June, or, as more practicable, toward the latter part of August. For remarks upon these methods, and for other remedies and preventives available against cut-worms as a class, see *Bulletin No.* 6 *of the N. Y. State Museum of Natural History*, on "Cut-worms," lately published; and the same in the *Transactions of the N. Y. State Agricultural Society*, vol. xxxiv, for the years 1883–1886.

Mamestra picta *Harris.*

The Zebra Cabbage Caterpillar.

(Ord. Lepidoptera : Fam. Noctuidæ.)

Harris : Ins. N. Engl., 1852, p. 350–1; Ins. Inj. Veg., 1862, p. 451–2, f. 223 (larva), f. 224 (pupa); Entomolog. Corr., 1869, p. 317–18 (larval description and dates).

Guenée : Sp. Gen. Lep., v.—Noct. i, 1852, p. 344, pl. 5, f. 8 (as *Ceramica exusta*—moth described).

Walsh: in Pract. Entomol., ii, 1866, p. 21 (immunity to frosts, etc.)
Riley: 2d Rept. Ins. Mo., 1870, p. 112, f. 82 *a* (larva), *b* (imago); in Rept. Comm. Agricul. for 1883, p. 124–5, pl. 1, figs. 3, 3a, pl. 12, figs. 2a, 2b (*Ceramica*—description, habits and transformations).
Lintner: in 26th Rept. N. Y. St. Mus. N. H. for 1872—Ent. Contrib., III, 1874, p. 137–8 (*Ceramica*—larval description and habits); 2d Rept. Ins. N. Y., 1885, p. 1–2 (on beets); 4th Rept. do., 1888, p. 16 (on currant); Bull. N. Y. St. Mus. N. H., No. 6, 1888, p. 21, f. 24.
Grote: in Bull. Buff. Soc. Nat. Sci.—List Noct., 1874, pp. 22, 123 (*Ceramica*); Check List N. A. Moths, 1882, p. 26, No. 343 (*Mamestra*).
Thomas: 6th Rept. Ins. Ill. [1877], p. 60; 9th Rept. do., 1880, p. 51–2 (*Ceramica*).
French: in 7th Rept. Ins. Ill., 1878, p. 226 (*Ceramica*).
Coquillett: in 10th Rept. Ins. Ill., 1881, p. 185, figs. *a*, *b* (*Ceramica*).
Packard: in Amer. Nat., xviii, 1884, p. 1266–7 (larval stages described).
Caulfield: in Canad. Entomol., xvi, 1884, p. 122–3 (Ophion parasite).
Weed: in Bull. Ill. St. Lab. N. H., iii, 1887, p. 2 (Microplitis parasite).

This conspicuously marked caterpillar, shown, together with the moth produced by it in Figure 18, which is so injurious to many kinds of vegetation, has often been described and figured in its mature form, but only a few brief notes of its earlier stages have been given. Examples sent by Mr. George T. Powell, from Ghent, N. Y., June 8, 1887, found feeding in company on a currant bush, enable me to supply the deficiency.

Fig. 18.—Mamestra picta, showing the moth and its caterpillar.

The Young Larva.

The larvæ were 0.35 inch in length, and cylindrical in form. The head is pale red, and nearly as broad as the body. The body is traversed dorsally by a bluish-white mesial stripe, except as it is interrupted at the incisures on the posterior segments by the coalescing of the two well-defined black stripes that, commencing on the white collar of the first segment, elsewhere border it. Below this is a distinct bright yellow subdorsal stripe, broader than the black one above it, in which, on the hinder part of each segment, is a small, black setiferous tubercle—its seta a little longer than the breadth of the stripe; these tubercles, on the posterior segments, are merged

into the black stripes above. Next below is a broad, black, lateral stripe, traversed by an irregular white one, which is contracted on each segment so as to leave thereon a large rounded black spot united with the lower margin of the black stripe. The stigmatal stripe, next in order, is yellow, somewhat narrower than the subdorsal yellow one, bearing a row of black setiferous tubercles, similar to those in the superior yellow stripe, of which the anterior ones are merged in the black above. Below this, and centrally, the body is blackish, paler mesially. The legs and prolegs are reddish, the latter with a black patch outwardly.

The larvæ, at this time, have molted twice — possibly three times.

From the above details, it will be seen that the caterpillar is marked with seven distinct stripes, viz., three black ones (a dorsal and two lateral) and four yellow ones (two subdorsal and two stigmatal).

The Nearly Mature Larva.

In the stage previous to the last molt, the broad, dorsal black stripe is traversed medially by a narrow white line, and is marked on the hinderpart of segments three to nine with two small white dots. The broad, black lateral band consists of the black runic markings, with white interspaces, characteristic of the last stages of this larva.

A Peculiar Parasitic Attack.

In this stage six of the caterpillars disclosed a parasitic attack. In each instance, underneath the last segment of the larva, and usually placed transversely to it, an elongated brown cocoon, about twice as long as broad, was found attached.* Its formation was not observed. The diameter of the cocoon about equals that of the caterpillar. The parasitic larva may have emerged through the anus, as no rupture in the skin was observed. The cocoons were formed June twenty-second to June twenty-sixth. The cocoon and the insects emerging therefrom (date not known) are identical with those subsequently described by Mr. Clarence M. Weed (*loc. cit.*), of the Ohio Agricultural Experiment Station, as *Microplitis mamestræ.*

Transformations.

On the twenty-seventh of June the larvæ had matured and entered the ground for pupation. The moths emerged August eleventh to eighteenth, and deposited eggs, the earliest of which hatched August twentieth.

It will be observed, from the above, that there are two broods of this insect each year — the first of which appears abroad in the winged state about the latter part of May, and deposits the eggs for

* Mr. Weed found the cocoons "fastened transversely between the anal prolegs."

the summer brood. The caterpillars from these, feeding through June, produce their moths in August. From these, again, we have the caterpillars which are so destructive to autumnal crops in September and October, which pupate in the latter month, and pass the winter in that stage.

The larvæ obtained from the eggs on August twentieth enable me to give their features at an earlier stage than that previously given.

When just from the egg, they measure one-twelfth of an inch in length. The head is black, and the flesh-colored body bears rows of rounded, black, setiferous spots — the superior four of which on each segment form the "trapezoidal spots." The hairs are black. The larva loops in walking, as only six of the prolegs are employed in locomotion.

Food-plants.

In addition to the list of food-plants of this caterpillar (apparently rather a general feeder on garden crops) given by Professor Riley, viz., cabbage, turnip, beet, spinach, strawberry, asparagus, honeysuckle, mignonette, asters, lamb's quarters (*Chenopodium album*), may be added from my own observations, sweet pea, field pea, currant, and buckwheat.

On July 3, 1884, Mr. Goff sent from the Agricultural Experiment Station at Geneva, larvæ of from three-eighths to one-half inch long, which may have undergone two molts, that were infesting, to a serious extent, peas and cabbage on the station grounds. For mention of a severe attack by the caterpillars on a mangold crop, in St. Lawrence Co., N. Y., in 1883, see my 2d report.

Remedies.

It is comparatively easy to deal with this insect while in its early stages when it is of social nature and feeds in companies. At this time the leaves containing them may be plucked and crushed by the foot.

Later, they may perhaps be best destroyed by pyrethrum powder, to which they are quite susceptible, as shown by the following experiments made:

Undiluted pyrethrum was scattered over five larvæ, less than half-grown. They were very soon in violent convulsions, squirming and twisting as if in great agony and discharging a green liquid from the mouth. In a half hour's time they were unable to turn from one side to the other, and only gave contractile movements. In three-fourths of an hour motion had nearly ceased. In one hour and a half they were motionless and seemingly dead.

Pyrethrum of the dilution of one part to five of flour was slightly dusted through a sieve over five larvæ. In three minutes time, they had ceased traveling and were violently squirming. In fifteen minutes time, they were barely able to turn themselves over. In one-half hour they showed no more motion than did those which had been treated with unmixed pyrethrum after the lapse of an hour. The experiment clearly showed that the diluted powder was not only quite as efficient as the undiluted, but even more rapid in its effect.

Mamestra grandis (*Boisd.*).

A Poplar-feeding Cut-worm.

(Ord. Lepidoptera: Fam. Noctuidæ.)

Hadena grandis Boisduval: Gen. Ind. Eur. Lepidop., 1840, p. 950.
Hadena grandis Guenée: in Ann. Soc. Ent. France — Noct. Eur. Ind. methοd., 1841, p. 244; Spec. Gen. Lep., vi.—Noct., ii, 1852, p. 105, pl. 8, f. 10.
Mamestra grandis Grote: List Noct. N. A., in Bull. Buff. Soc. N. S., ii, 1874, p. 12.

An irregularly rounded cluster of the eggs of this cut-worm was taken at Center, N. Y. (Karner), on the 14th of June, 1887, on the leaf of a poplar, *Populus tremuloides.* They were not identified at the time, nor even later when the larvæ had been reared from them, nor until the moths were obtained the following winter.

Eggs of other of the cut-worm moths have been taken from various trees. As there is no record of the larvæ of such species feeding upon the leaves where the eggs occur, we may presume that immediately upon hatching, the young larvæ drop to the ground and commence to feed upon the tender blades of grass. It is possible, however, that some of the species may creep at night from their hiding places — in crevices in the bark of the tree in their younger stages, and in the ground when more advanced — to feed upon the leaves unobserved, as *Agrotis Cochranii* and others of the "climbing cut-worms" are known to do. That this may be their habit seems plausible from the food upon which this family of *M. grandis* was reared. Their cut-worm nature not being suspected from their egg or larval features, poplar was supposed to be their natural food-plant and it was accordingly given them immediately upon their hatching. It was readily accepted, and continued thereafter to be eaten with apparent relish. They even consented to a transfer to other species than *P. tremuloides,* when, hav-

ing been carried with me in the Adirondack mountains, that particular specie of poplar, at times, could not conveniently be obtained.

The following is the account of the successive stages of *Mamestra grandis* as observed by me:

The egg.—The egg is round, ribbed with about twenty-four lines and punctured in the intermediate depressions. Color, a pale purple, an elongate deep purple dash at the apex, and a purple band near the summit not entire. The colors were probably the result of the larva partly showing through the translucent shell, as the hatching was near at hand, and the empty egg-shells were left nearly colorless.

Larva in first stage.—The larvæ were hatched on the fifteenth of June. They were quite small, slender, elongated, with long legs and numerous black spots from which long hairs proceeded. They are very active in their movements. When ready for their molting, they are of a pale, watery-green color, with three pale (whitish) stripes on each side; between the two lower is a dusky stigmatal stripe. The black, setiferous, trapezoidal spots are quite distinguishable, and of these the two anterior ones of the central segments, are about one-half as far apart as the hinder pair. Length when fixed for molting, 0.3 inch. Four pairs of prolegs are used in walking in this stage.

Second larval stage.—The first molting was on June twenty-second. The head is flat, pale brown, with a few dark spots. The body, bluish-green; a narrow, whitish, dorsal line; two lateral lines, then a dark stigmatal one, having a white stripe below. Ventral region pale green. The fifth pair of prolegs are partly developed, but not employed in locomotion, as the larva still loops.

Third stage.—Commencement of second molting not noticed, but was on or about the twenty-seventh of June. General color, darker green; a whitish dorsal stripe, a similar lateral one, a broad dark green stigmatal one, below which is a pale green stripe, bordered on each side with white. Head, brown, flat, bilobed, with numerous hairs. Body tapering anteriorly from the eleventh segment; the setiferous spots with comparatively shorter hairs. Of the five pairs of prolegs, the anterior pair is used in walking, but as they are shorter than the others, the larva still has a looping gait. It feeds principally at night; when disturbed, it coils up and bends its head on one side. At this stage, it eats holes in the body of the leaf, and not from the edge as before. Length when in readiness for its next molt, 0.7 inch.

Fourth stage.—Molted on or about July second. Color, pale brown; a whitish dorsal line, two obscure lateral ones, and a stigmatal and

substigmatal whitish one. Head nearly as large as the first segment, pale brown with two darker lines down its front and paler reticulations on the sides. Body cylindrical. All of the prolegs are fully developed and there is no looping in walking.

Fifth stage.— On July ninth the larvæ were observed in their fourth and last molting. At maturity, they measure when at rest 1.5 inch, and are nearly cylindrical in form; when extended in motion they are two inches long with the body tapering quite regularly from the eleventh segment to the head. The head is bilobed above, flattened in front, brown, with darker brown reticulations. The body is an obscure pale brown, with indistinct dark brown mottlings, smooth, except the usual setiform spots, each with a short white hair; trapezoidal spots dark brown and inconspicuous — the anterior pair contiguous. Beneath, paler; legs unicolored.

The larvæ were fed on poplar leaves to maturity.

Pupation.— First change to the pupa on July twenty-first — the last on July thirtieth — about thirty in all. Most of the larvæ declined to enter the ground that was given them, but pupated on the surface. After their pupation they were covered lightly with earth. A few buried two or three inches in the ground, where they made rude cocoons of earth by spinning together the surrounding soil in walls of about one-fourth of an inch in thickness.

Disclosure of the Imago.— The pupæ were kept during the winter in a warm room, having a temperature of 70° Fahr. and above. Although the breeding-case in which they were placed was supplied underneath its wire floor with an evaporating pan to furnish needed moisture, very few moths were disclosed. The first emerged in January, 1888 — three examples prior to January twenty-first. A second and third example followed during the month, and four others in February; and although the pupæ seemed in good condition for months thereafter, and some occasionally worked their way to the surface when covered only with a thin layer of earth, no other examples of the moth were obtained. The moth bears such a general resemblance to *Hadena Arctica* (Boisd.), that it was at first mistaken for it. It is represented in Fig. 19.

Fig. 19.— Mamestra grandis.

Distribution.

Mamestra grandis has rarely occurred among the large collections of *Noctuidæ* made in the vicinity of Albany during the years 1877 and 1878 by Messrs. Meske, Hill, Bailey, Chatfield, and others. It is

recorded as having been taken rarely in Ohio and Illinois. Beyond this, but little is known of its distribution in the United States. It is said to occur in the circumpolar regions of Europe. Boisdaval received examples of it from Greenland and Lapland.

Penthina nimbatana (Clemens).

The Rose-Leaf Tyer.

(Ord. Lepidoptera: Fam. Tortricidæ.)

Clemens: in Proc. Acad. Nat. Sci. Phila., 1860, p. 364 (*Antithesia*).
Walker: in Cat. Lep. Heteroc. Br. Mus., xxviii, 1863, p. 374 (*Penthina contrariana*).
Zeller: Beitr. Kennt. nordamer. Nachtf., iii, 1875, p. 57, pl. 8, f. 13.
Fernald: Cat. Tortric. N. Amer., 1882, p. 31, No. 187.
Coquillett: in 11th Rept. Ins. Ill., 1882, p. 12 (reference to); in Papilio, iii, 1883, p. 101 (larval features and habits).
Lintner: in Count. Gent., xlviii, 1883, p. 169 (in a green-house).

Caterpillars of this moth were received from Scarsdale, Westchester Co., N. Y., on February seventh, with a statement that they had just made their appearance in a green-house and were injuring the foliage. Some method of destroying them was desired.

They are of small size, as are most of the family of *Tortricidæ* to which they belong, not much exceeding one-half inch in length, slender, and nearly cylindrical. They are of an apple-green color, of a transparency that permits the pulsation of the dorsal vessel (corresponding to a heart) to be seen through the skin, and are traversed by a dark dorsal line. The twelve segments of the body are well defined, each bearing several small tubercles or papillæ which give out a small white hair — the four on the back (the trapezoidal spots) being the most conspicuous. The head is flat and shining black, with some whitish hairs, and the collar (upper part of the first segment) is also shining black. The three pairs of legs are black; the prolegs green.

This species was named and described by Dr. Clemens as *Antithesia nimbatana*, in 1860, and was later referred to the genus *Penthina*. It is a common species in the vicinity of Albany.

Mr. D. W. Coquillett states (*loc. cit.*) that he has found the caterpillar of this species to be "utterly indistinguishable from a black-headed variety of *Cacœcia rosaceana* (Harris)." I have not compared the two, but the moths are so exceedingly unlike that their larvæ certainly should show differential features. From my recollection of the larva of *P. nimbatana*, its green is more yellowish and clearer than

is ever seen in examples of *P. rosaceana.* A number of the pupa-cases of both species are contained in the State collection, awaiting study which will undoubtedly show marked differences in them.

Food-habits.

With me the insect has shown a decided preference for some clumps of one of the commoner roses, not very double, which grow in clusters on the same stem, and entirely avoiding some of the choicer kinds. This same preference has been observed and mentioned to me by others. The explanation may, perhaps, be that this particular rose is apparently not very far removed from the wild rose, *Rosa blanda,* which, according to Mr. Coquillett, it infests, and from which he has bred it.

This is the first time that the insect has been reported in green-houses.

Life-history and Habits.

The parent moth, shown in its natural size in Fig. 20, comes from its pupa about the middle of April in ordinary seasons, in the State of New York, for the deposit of its eggs. They are laid at night, and presumably on the terminal leaves of rose bushes, just as they are pushing out from the buds. The eggs have not been observed, nor the moth in its oviposition, at this season of the year. The caterpillar soon hatches, and at once commences to bind together the margins and surfaces of the folded leaf. I have found it thus located on the last day of April, measuring one-eighth of an inch in length. With its increasing size, the single leaf, partly eaten and opened out in its rapid growth, is abandoned by the caterpillar, which then selects another habitation, and a more commodious one, between the surfaces of two leaves fastened together. This, in turn, at a more advanced stage of growth, is deserted for still more ample quarters among several of the terminal leaves of a tip. Within the shelter thus provided for itself, it feeds upon its immediate surroundings and is never seen abroad. Its growth is rapid, and at its successive moltings the papillæ and the hairs proceeding from them become more conspicuous. Immediately after its molting, and for a while thereafter, its head and collar are green, assuming slowly their normal black and shining color.

Fig. 20.—Moth of the rose-leaf tyer. Penthina nimbatana.

By the last week of May the larvæ have matured, ceased feeding, and, it would seem, have dropped to the ground, to undergo their transformations among the dead leaves, as I have not been able to find their pupæ among the folded or fastened leaves of the bush. When reared in confinement they have transformed within a folded

leaf which the caterpillar had first lined with a coating of silk. The period of pupation is about nine or ten days. The moth of the second brood has been observed abroad by me as early as June second. Eggs are laid for the next brood, and the renewed operations of the caterpillar upon the bushes are soon to be seen, extending into July. It is possible that there may be a third brood, as the transformations among the *Tortricidæ* may be quite rapid — the pupal stage in some being limited to five days. I have seen the moths flying in my garden as late as July twenty-fifth — the latest period at which I have been able to pursue my observations upon it. From June second to the last days of July, and probably into August, would be too long a time for moths of the second brood to be seen abroad. It would be more in accordance with what is known of other Tortricids if a third brood made its appearance about the middle of July.

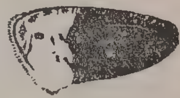

Fig. 21.–Front wing of the rose-leaf tyer, enlarged. (After Zeller.)

Remedies.

The presence of this caterpillar on a rose bush may be detected at a glance by the tied leaves at the tip of a stem, when it is only necessary to give the little bunch a slight pinch, and its occupant is at once destroyed. As it is seldom so numerous as to call for insecticidal applications to the entire bush, which would require to be very thoroughly applied in order to reach its food, this will be found the most convenient and efficient method of destroying the pest. It is the method that I have adopted in my own garden, where it is an annual visitant, and where its pretty, broad-winged and conspicuously marked moth is often to be seen by day during the months of June and July, resting upon the leaves, or if disturbed, flying quickly for a yard or two to a fence-board or other convenient resting place, and presenting much, in the pose of its wings, the appearance of some of the smaller *Noctuidæ*.

Incurvaria acerifoliella (Fitch).

The Maple-leaf Cutter.

(Ord. Lepidoptera : Fam. Tineidæ.)

Ornix acerifoliella Fitch: in Trans. N. Y. St. Agricul. Soc. for 1855, xv, 1856, pp. 501–505; 1st and 2nd Repts. Ins. N. Y., 1856, pp. 269–273, pl. 4, figs. 5–7; in Count. Gent., xiv, 1859, p. 225.

Incurvaria acerifoliella Clemens: in Proc. Acad. Nat. Sci. Phila., January, 1860, p. 4; in Tineina of N. Amer., 1872, p. 90 (fig. of wings and brief description).

Ornix acerifoliella. Reed: in Rept. Ent. Soc. Ont. for 1872, p. 42-3.— Lintner: in Count. Gent., xxxix, 1874, p. 631.

Tinea iridella Chambers: in Canad. Ent., v, 1873, p. 86.

Incurvaria iridella Chambers: in Canad. Ent., xi, 1879, p. 146; in Bull. U. S. G.-G. Surv. Terr., iv, 1878, p. 151.

Incurvaria acerifoliella. Chambers: in Bull. U. S. G.-G. Surv. Terr., iv, 1878, p. 151 (references).— Packard: in Bull. No. 7, U. S. Ent. Commis., 1881, p. 114 (habits and description).— Walsingham: in Trans. Amer. Ent. Soc., x, 1882, p. 172; in Insect Life, i, 1888, p. 147.— Lintner: 1st Rept. Ins. N. Y., 1882, p. 308 (mention).— Fletcher: Rept. Entomol. for 1885, p. 31-2 (severe injuries); id. for 1887, p. 38 (mention); in Trans. Ottawa Field Nat. Club, ii, 1887, p. 353-4 (injuries).

This little Tineid, for some unknown reason, is remarkably local having been reported from only a few localities in the United States and Canada; yet when it makes its appearance, it is usually so destructive to the foliage of the trees that it attacks, and its operations are of such a peculiar character as to impart much interest to them.

The following communication, received from a correspondent residing at Pittsford, Vt., tells the story of a demonstration made by it at that place:

Inclosed I send you some leaves from the sugar maple, upon which you will find a small worm covered with portions of the leaf which he has cut out and appropriated for a house; he carries it about and feeds upon the leaf until it is all consumed but the fiber. Nearly all the hard maple trees in our forests are as brown and look as dead as though fire had been through them. We have never seen anything of the kind here before, and I would like to know where they came from and what their future will be. They touch no other tree but the hard maple; not even the soft maple. Any light in regard to the insect will be thankfully received.

The Leaf-case of the Caterpillar.

The leaves sent with the above present a curious appearance and would naturally arrest attention and provoke inquiry. In one of them are no less than twenty-two round (or more correctly, subelliptical) holes, of from one-tenth to four-tenths of an inch in diameter, while several of the pieces, neatly cut out from the holes, are fastened to the upper surface of the leaf. A large portion of the surface has been eaten away in such a manner as to leave frequently circular patches of green untouched surface, corresponding in size and form to the excised pieces of leaf.

Upon inserting the point of a needle under the edge of one of these pieces, it is found to be attached to the leaf by silken threads at different parts of its circumference. On raising it, underneath is seen a

smaller round piece, and within these two, when separated, two other pieces of smaller size, containing within them the remains of a minute caterpillar which had been killed, probably by pressure in transit through the mail.

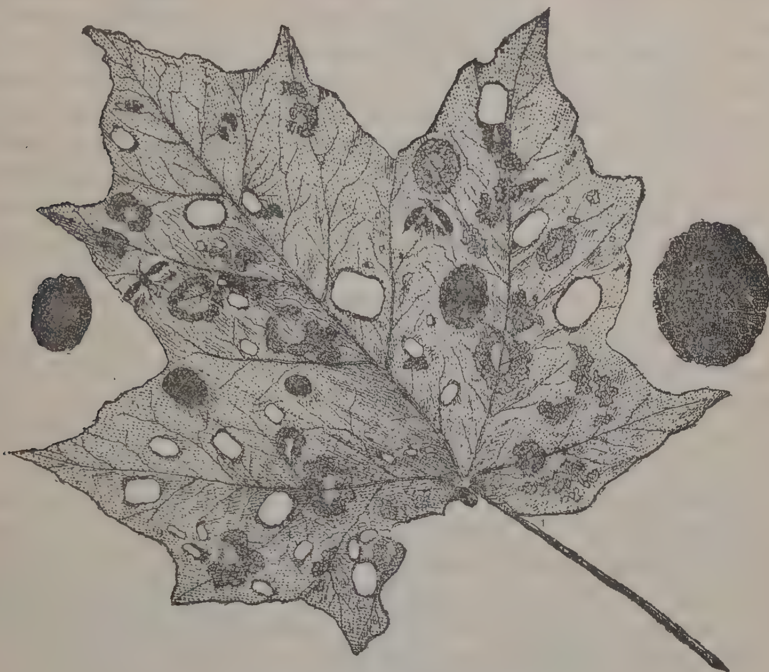

FIG. 22.—The maple-leaf cutter, INCURVARIA ACERIFOLIELLA, and its operations. (After Fitch.)

When the leaves were received, a few of the leaf-cases which had escaped crushing were observed in motion, as the caterpillars, with head and front legs protruded, were dragging them over the surface in search of fresh pasturage, as stated in the above communication.

In Fig. 22 the operations of this insect on a maple leaf, as above described, are shown, as also two of the moths upon the leaf in their natural size. Three of the larval cases, in different sizes, are represented on the leaf. At its left is the case of a full-grown larva, in natural size, and to the right the same enlarged.

The Insect, and its Appearance in New York in 1850.

The insect which constructs for itself this singular shelter, and inflicts the serious injury on the forest maples mentioned above, is known as the Maple-leaf cutter. The perfect insect proceeding from it, after its hibernation among the dead leaves on the ground in the pupa state, is a little moth of only a third of an inch in expanse of

wings, belonging to the family of *Tineidæ,* which comprises the smallest forms of the *Lepidoptera.* It was described thirty-five years ago by Dr. Fitch, in his *First Report on the Noxious Insects of New York,* under the name of *Ornix acerifoliella,* where it is recorded as having caused so serious an affection of the maples in the eastern section of New York, in the year 1850, as to make it a common subject of remark. The forest maples were alone affected by it; those isolated in fields and about dwellings entirely escaped. It had been observed for several years (perhaps ten) annually, with the return of the month of May, in numbers in the forests, but at the time of writing (1854) it had nearly disappeared; for two years past not one had been seen, and even its pupæ could not be found on searching among the fallen trees.

Its Subsequent History.

No record is found of later injuries from it in the State of New York. In 1859 Dr. Fitch received examples of the insect with inquiries of its habits, from North Clarendon, Vt., as appears from a communication made by him to the *Country Gentleman* of October sixth of that year. Its ravages at and in the vicinity of Pittsford, Vt., given on page 216, were in the year 1874. Dr. Packard's only acquaintance with the insect seems to be (*loc. cit.*) in maple leaves, and cases illustrating its work received from Vermont — at what time is not stated. Its occurrence in the State of Illinois was observed by Miss Emily A. Smith, on forest maples, during the month of August and thereafter increasingly until the fall of the leaves in autumn.

Its Destructiveness in Canada.

Mr. James Fletcher, Entomologist of the Department of Agriculture of Canada, has given an account of an extraordinary occurrence of this insect in a maple wood adjoining the grounds of the Government House at Ottawa, in September of 1885. The maple trees, for a space of perhaps four acres, had the foliage almost entirely consumed, and the flat, disc-like cases of the larvæ were carpeting the ground, and were also in great numbers on the trunks of the trees. Some beech trees growing among the maples had also been attacked after the leaves of the maple had been devoured. The attack was so severe in the skeletonizing of the leaves that the woods presented a cream-colored hue instead of their usual green.

A similar visitation had been observed by the Rev. T. W. Fyles, of South Quebec, in Missisquoi county, in the year 1881, particularly in maple groves in the village of Sweetsburgh, Quebec. The foliage was so skeletonized that it presented a brown and scorched appearance, as if a hot blast had passed over the woodland. Myriads of the larvæ

in their disc-like covering were to be seen on the leaves and branches of the trees and on the undergrowth. The following season clouds of the perfect insect would rise from the foliage when disturbed by the passers-by.

Elsewhere in Canada — which, from the above accounts, would seem to be the home of this insect, from which it, at times, extends southward into Vermont and New York — it has been observed in the London district by Mr. E. Baynes Reed, who records it (*loc. cit.*) as more or less common every year in that locality, and notably in the year 1872.

Caterpillar and Moth Described.

The larva is described by Dr. Fitch as nearly one-fourth of an inch long at maturity; slender, and of a flattened cylindrical form, soft and contractile, its segments marked by slight, intervening constrictions. It is of a dull white; the head, which is strongly depressed, and the three thoracic segments are pale rusty-brown; an interrupted broad, blackish stripe, more or less distinct, traverses the middle of the back.

The moth measures 0.35 inch acr ss its forewings, which are of a brilliant steel-blue color, or sometimes bluish-green, with a purple reflection, and without spots. The hind wings are pale smoky-brown and translucent, with pale blue and purple reflections and a pale brown fringe. On the crown of the head, between the antennæ is a tuft of erect bright orange hairs. The thorax is brilliant steel-blue, and the abdomen of a dark satiny-brown.

Fig. 23.— The maple-leaf cutter, Incurvaria acerifoliella (after Fitch).

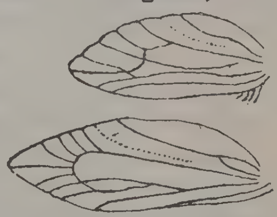

Fig. 24.— Neuration of wing of the maple-leaf cutter.

Figure 23 (after Fitch) represents the moth in enlargement, and Figure 24 (after Clemens) the neuration of its wings.

Remedies.

As the insect pupates within the leaves, and remains in them after their fall during the winter, its numbers may be greatly reduced in maple groves by permitting cattle or sheep to range therein, and attracting them to the more particularly infested trees, if such there are, by feeding salt beneath them, as suggested by Dr. Fitch.

When isolated shade trees are attacked, as they sometimes are (on the authority of Mr. Reed), the depredations may be arrested by spraying with London purple — one pound to 200 gallons of water.

Hæmatobia (Lyperosia) serrata (Rob. Desv.).

The Cow-horn Fly.

(Ord. Diptera: Fam. Stomoxydæ.)

Hæmatobia serrata Rob. Desvoidy: Essai sur les Myodaires, 1830, p. 389, 3.
Hæmatobia serrata. Macquart: Suites à Buffon, ii, 1835, p. 244.
Lyperosia serrata Rondani: Dipterologiæ Italicæ Prodomus, v, 1862, p. 231.
Priophora serrata Rob Desv.: Hist. Nat. Dipt., 1863.
Stomoxys cornicola Williston MS.: Lintner: in Count. Gent. for Oct. 18, 1888, liii, p. 779.
Hæmatobia serrata. Lintner: in Count. Gent. for Nov. 29, 1888, liii, p. 893.
Hæmatobia cornicola Williston. Smith: in Count. Gent. for Aug. 8, 1889, liv, p. 591–2 (description, figures, habits, etc.): Bull. F. N. Jer. Agricul. Col. Exp. St., 1889 (habits and remedies).
Hæmatobia cornicola Williston: in Entomolog. Amer. for Sept., 1889, v, p. 180–1 (figure, description and notes).— Howard: in Insect Life, ii, 1889, p. 60.
"The Texas fly." Lintner: in Count. Gent. for Sept. 20, 1888, p. 705; id. for Oct. 11, 1888, p. 759.
"The Buffalo or Texas fly." Pacific Rural Press for Aug. 3, 1889, p. 89 (in Iowa).

Hæmatobia serrata occurs in Europe, in Southern France and in Italy, where it is reported as tormenting cattle. Beyond this, very little, so far as we know, has been written of it and we may therefore infer that it has not been regarded in its native home as a particular pest.

Its introduction into this country must have been of recent date. It seems to have been first noticed in Chester county, Penn., in the year 1886. In the autumn of 1887, the attention of Professor Cope, of Philadelphia, was drawn to the fly, as greatly annoying cattle and congregating in large numbers on and around their horns. My attention was called to it in the summer of 1888, through a communication submitted to me and published in the *Country Gentleman* of September twentieth, as follows:

Farmers in this neighborhood are making quite a time about a small fly that gets on their cows' horns. They say that they bore into the horn and deposit an egg that hatches, and the grub burrows into the head of the cow and produces death. They are putting tar over the cows' heads and horns, which I do not wish to do. They call it the Texas fly. Please answer in your valuable paper if there is any danger, or whether it is all moonshine. H. F. A., *Hamilton Square, N. J.*

Reply was made to the above of ignorance of any insect having the habits above described and a doubt of the existence of such. That an injury of this nature might be inflicted was within the range of possibility, but if the fly existed in Texas, or elsewhere in the United

States, or in other countries, it would have been known long ago to scientists. The story as told, therefore, of the Texas fly, need not be credited, and it does not seem advisable to make the application of tar to protect from injuries which probably do not occur.

The publication of the above called forth the following communication, contained in the *Country Gentleman* of October 11, 1888, which gave us the first definite information regarding the habits of the new insect, and was also accompanied with specimens of the same:

Eds. Country Gentleman.— The small cow-fly referred to by your correspondent, on page 705, first attracted general attention in Chester county, Penn., in 1886. How long they may have been present in lesser numbers we do not know, but in that year they caused general comment by their habit of congregating on the horns of cattle, seeming at the first glance like a mass of tar, extending some three or four inches on the upper surface of the horn. Examination would soon show that they were not confined to the horns or head, but attacking the animal generally — neglecting, however, the legs and feet, where the ordinary fly is particularly troublesome. They especially feed on the shoulders and at the root of the tail — our cattle generally having a sore spot on the hairless skin on each side of the tail. They are, as will be seen by the sample mailed, about one-half as large as the ordinary fly, and quite like them in appearance. They avoid horses entirely, and appear to have largely reduced the number of their predecessors. They do not bite the milkers as the others did, and their several bites do not appear to annoy the cattle nearly as much as the old ones; but they are much more persistent, and come early in spring, long before "fly-time." For want of a better name, our farmers are calling them Texan flies.

It is generally affirmed that they cling to the cow and bite all night. From my own observations, I doubt their feeding then.

It would be of considerable interest to learn how much of our country the fly has appeared in, and when it was first observed. Your readers can give us the information, no doubt.*

J. L. B.

Kennett Square, Chester Co., Pa.

The fly was unknown to me. It was evidently closely allied to our well-known and common biting fly, *Stomoxys calcitrans* (Linn.), which appears in autumn and attacks animals and men, often entering our houses, and from its marked resemblance to the common house fly, not recognized as different until it inflicts a sudden, sharp, stinging bite through the stocking or elsewhere on the leg — seldom on any other part of the body. If captured and examined, the long, slender and projecting proboscis with which the bite is inflicted may be readily seen.

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*No one, as yet, has given an earlier date than the above for the first appearance of the fly, nor has its distribution been ascertained.

Upon making inquiry of Dr. S. W. Williston, who is conceded to be the best authority among us on American Diptera, of his knowledge of the insect, reply was made that he had received specimens of it from several sources during the past year, and that it was a new species of *Stomoxys* which he would soon describe under the name of *cornicola.**

Previous to this, it seems to have excited considerable attention throughout the State of New Jersey during the year 1887, and was accordingly made the subject of inquiry and remark at the Annual Meeting of the State Board of Agriculture held at Trenton on the 3d of February, 1888. The principal statements of interest made, were, that it appeared at different localities about the same time, viz., in the early morning before daylight. It was particularly fond of fastening itself on the udders of the cows, or where the skin of the animal is the thinnest. When the animal is lying down it settles on the thin skin behind the shoulder-blades. It often collected about the horns, and this spot would be covered with its excreta. It followed the cattle into the stall where it annoyed them both in the morning and evening. It had not been seen on horses or mules — only on cattle. Specimens of it had been sent to the Department at Washington, and it was learned from the Entomologist that it had not been seen by him before, and could not at present be named.†

Identical with an European Species.

Although new to all of our entomologists, it did not seem wise to accept it as a species that had long been with us and chanced to have remained undetected until it suddenly developed a new and peculiar habit of annoyance. So many of our more noted insect pests have, through the daily intercommunications of commerce been transferred from Europe to our shores, that it was quite probable that this also had a similar origin — the more so since the Diptera could be so easily carried on shipboard. A number of examples of the fly were therefore obtained and sent to Baron Osten Sacken of Heidelberg, Germany, whose special study of the Diptera during the past forty years, both in this country and in Europe have given him the highest rank among the Dipterologists of the world. He kindly returned answer that the insect, although a true Stomoxyd, and allied to *Stomoxys calcitrans*, was easily distinguishable from it in the following characters: 1. Its smaller size and more uniformly grayish-brown color. 2. Its long palpi, nearly as long as the horny, porrect proboscis. 3. The structure of the hind tarsi in the male, the two long basal joints of which show a

* See *Country Gentleman* of October 18, 1888, p. 779, where the proposed specific name is erroneously given as *cervicola.*

† *Fifteenth Ann. Rept. N. J. State Board of Agriculture*, 1888, p. 163.

triangular projection which makes the edge of the tarsus appear serrate; hence its specific name. It was the *Hæmatobia* (*Lyperosia* Rond.) *serrata* of Rob. Desvoidy.

The determination of the specific name had been made by his friend, Mr. F. Kowarz, to whom some of the specimens were sent, in consideration of his superior knowledge of European Diptera. He had written that "the most careful comparison has not disclosed any differences between the American and the European specimens of this fly."

European Bibliography of the Fly.

Baron Osten Sacken, with his accustomed kindness, also communicated the European bibliography of the insect herewith given, together with the following remarks upon the generic terms employed therein, which will be appreciated by the scientific student:

As there are several other species of *Hæmatobia* in existence, Rondani formed the genus *Lyperosia* (Prodr., etc., i. p. 92, 1856) for those of them which have the arista beset with hairs on the upper side only, and the end of the first longitudinal vein *opposite* the small cross-vein. In the remaining Hæmatobiæ the arista shows some few hairs on the under side also, and the first longitudinal vein reaches *beyond* the small cross-vein.

The genus *Priophora* was proposed by R. Desvoidy (in his posthumous work, Hist. Nat. Dipt., etc., 1863) for *H. serrata*, on account of the structure of the hind tarsi in the male. Robineau [Desvoidy] did not know of Rondani's publication; nevertheless *Priophora* and *Lyperosia* are *not* synonyms, and are based on different characters, viz., *Priophora* on the male hind tarsi, *Lyperosia* on the mode of hairiness of the arista and on the venation; *Priophora*, in Robineau, contains the single species *serrata;* while Rondani's *Lyperosia* contains *serrata* and *irritans*.

Doubt Expressed of its Introduction.

Prof. J. B. Smith, of the New Jersey Agricultural Experiment Station, in a recent publication on the fly (*loc. cit.*), expresses his belief that it is not an introduced species, and that there is no real reason for supposing it to be other than an American form which abnormal circumstances have raised to the rank of a temporary pest. It is but just to Prof. Smith to state that the opinion was expressed, and the MS. name of *H. cornicola* given it by Dr. Williston, accepted without the knowledge of the positive identification of the fly with the *H. serrata* of Europe, from the examples sent by me for comparison, as above stated. It is also learned from Dr. Williston, that his quite recent publication of *Hæmatobia cornicola* new sp., was also made in ignorance of the above determination — since unhesitatingly accepted by him.

The Fly Illustrated.

Those who desire a description of the fly may find it in the *Country Gentleman* or in *Entomologica Americana,* as cited. As preferable to a detailed description for the use of the agriculturist or stock grower, the illustration by Prof. Smith, given in the above places, is herewith presented.

FIG. 25.—The Cow-horn fly, HÆMATOBIA SERRATA: *a*, the egg; *b*, the imago or perfect insect; *c*, head of the same seen from its side, showing the proboscis at rest; *d*, mouth-parts, showing the long palpi and the proboscis with its lancets thrown out.

Life-history and Habits.

The interest excited by the sudden advent in great abundance of a new pest, together with the greatly exaggerated reports of the character and amount of injury it would inflict upon the cattle interests of the country, have drawn the earnest attention of some of our entomologists and others to it, but as yet we are without a published life-history of it. It is now generally known, however, that the fly does not deposit its eggs on the animal, the grubs from which bore into the horns and penetrate the brain, as at first believed, but that it oviposits largely, if not altogether, in fresh cow-droppings.

The egg, of a deep brown color and larger than that of the common house-fly, has been described by Prof. Smith, and Mr. L. A. Howard has given the entire period of development of the insect from the egg through the larval and pupal stages to the perfect fly, as only twelve days. A knowledge of this fact satisfactorily accounts for the rapidity of multiplication of the insect seen after its first appearance in the month of May.

Mr. E. Boder, of Freehold, N. J., who has apparently given close attention to the fly, has kindly furnished me some of his observations, from which I extract:

"In my observation in a pasture-field this morning I found a lot of horn-fly eggs on manure dropped last night and this A. M.— only on droppings that were in the shade. The eggs were scattered over the top and not buried in the manure as those of other cow-flies, and which, I think, prefer the sun."

A number of the eggs thus found were sent me on different occasions, upon their bedding, but they could not be recognized when received, nor were larvæ from them found within. Two other species of *Muscidæ* were obtained from the masses, about fifteen days after reception, but no examples of the horn-fly. Others have experienced the same difficulty in attempts to rear the species.

Some other statements of habits, etc., contained in Mr. Boder's letters, are these:

Not one in fifty of the flies appear to be blood-suckers, judging from their actions by daytime, and, also, by crushing them fresh from the cow. Those that are blood-suckers also bite at night the cattle that are left out all night. For the past month (August), a portion of the flies have come to stall with the cows that are stalled all night.

It may be prejudice, but from my view, our common cow-fly [*Stomoxys calcitrans*], for biting, beats this new pest twenty to one in worrying the cows.

The fly subsists on the loose, soft part of the horn, near the head, and also, apparently, on the hair or dandruff, or both. [We can not imagine what operation of the fly has been mistaken for this feeding, for it is known that its mouth-parts — even of the male, which probably does not subsist on blood — are entirely unfitted for taking other than liquid food].

Heavy rains seem to be unfavorable to the production of the fly — perhaps through destroying its eggs. Ants and beetles of several kinds explore every piece of the droppings favorable, and apparently destroy millions of the maggots.

As these pages are about being handed to the printer, the gratifying information is received from Mr. Howard, of the Entomological Division at Washington, that they have secured full notes of the insect, have traced every stage of its life-history and have had a number of illustrations made, which will be published either in the Annual Report of the Entomologist, or earlier in Insect Life.

The Injury to Cattle.

The nature of the injury caused to cattle, from the attack of this fly, and its extent, has been so ably summarized by Prof. Smith that we copy the following from his paper cited, as best covering our present knowledge on the subject:

When many of these flies are at the cattle, of course the pain caused by the poisoned punctures is almost incessant; the cattle throw their heads about, lash their tails, and in every way try to get rid of their

tormentors. These, on the other hand, congregate at those points where they can not be easily reached, and the cattle are kept in a state of constant excitement. Judge Forsyth writes: "They live on them day and night and never leave them. My cows have shrunk in cream full one-half; the milk will not make but little more than half it did before the flies came." This is the primary injury caused. The cows kept in a constant state of annoyance, become poor and fall off in milk; secondarily, the cow, to get rid of the pests on her horns, and to allay the itching of the punctures at the base, will rub her head and horns against anything convenient to scratch, and inflammation of even a severe character may result — possibly even to the loss of one or both horns. There is no such thing as burrowing into the skin either by the larva or the imago, but the facts, as I have detailed them, are bad enough, since the result is the same, even if common observation has mistaken the actual cause.

Its Distribution.

Thus far the fly has been observed infesting cattle in northern Virginia, Maryland, Delaware, Pennsylvania, and New Jersey. I have not heard of its presence in New York, but in all probability it is to be found in some of the southeastern counties of the State.

The statement of its presence in Iowa, made in the *Pacific Rural Press* of August 3, 1889, and of the injuries inflicted by it, needs verification — the latter, to the extent stated, of course, can not be accepted.

The Buffalo fly, or Texan fly, an insect but half as large as the common house-fly, has been killing off the cattle in southeastern Iowa for some weeks past. A dispatch from Burlington states that the pests have caused the loss of several herds in that vicinity. They attack the cows at the base of the horns, and after a few days the horns come off. In another day the cow dies. Many beasts are suffering in a similar manner, and there has not been any remedy discovered that will effectually destroy the fly.

Preventives and Remedies.

It is believed that this new pest will not prove to be a difficult insect to control. There are several applications much less objectionable than tar that can be used for keeping the flies from alighting on the animal, or at least from remaining long enough to puncture the skin or be an annoyance otherwise. Crude kerosene oil, it is claimed, will accomplish this, without harm to the animal. The Division of Entomology at Washington has recommended the following: (1) Fish-oil and fine tar with a little sulphur added; (2) tobacco dust when the skin is not broken; (3) tallow and a small amount of carbolic acid.

Some oil mixed with "soluble phenyle" or almost any one of the popular "sheep-dips," properly applied, should prove efficient.

Professor Smith recommends very highly a tobacco-dust preparation known as X. O. Dust and manufactured by the Insecticide Manufacturing Co., at 10 East Camden street, Baltimore, as safe in use and prompt and efficient in action. He asserts: "If thoroughly applied so as to get the hair well dusted, no *Stomoxys* or *Hœmatobia* can stand it long enough to puncture the skin of the cattle. It would mean death to them. The powder does not lose strength by exposure."

But the best way to meet the insect, would, in all probability, be to destroy it in its earlier stages by applying lime to the droppings. If this be done on successive mornings, the eggs would be killed before their hatching and entering the manure as maggots. The suggestion of Mr. Howard is therefore valuable — to prevent the insect surviving the winter by liming the dung in the autumn where the cattle frequently stand at night. It being here that the eggs are deposited and where by far the larger number of the insects will probably hibernate, if the liming be done so thoroughly as to be carried or trodden into the droppings, it certainly should destroy all the horn-flies in its early stages that might otherwise survive the winter.

Dynastes Tityus (Linn.).

The Spotted Horn-bug.

(Ord. Coleoptera: Fam. Scarabæidæ.)

Linnæus: Syst. Nat., ii, 1767, p. 542, No. 5 (*Scarabœus Tityus*).
Fabricius: Syst. Ent., viii, 1775, p. 18; Sp. Ins., i, 1781, p. 8, No. 23 (*Scarabœus*); Ent. Syst., Pt. i, 1792, p. 10, No. 25; Syst. Eleuth., i, 1801, p. 10, No. 28 (*Geotrypes*).
Say: Amer. Entomol., i, 1824, p. 8; Compl. Writ., i, 1883, p. 8, pl. 4 (*Scarabœus*).
Fitch: 3d Rept. Ins. N. Y. (3d–5th Repts.), 1859, p. 49, No. 72.
Glover: in Rept. Commis. Agricul. for 1868, p. 89, f. 80.
Riley: in Amer. Entomol., ii, 1870, p. 374, f. 224.
Horn: in Trans. Amer. Ent. Soc., iii, 1870, p. 78 (var. *Grantii*).
LeBaron: 4th Rept. Ins. Ill., 1874, p. 84, f. 38.
Thomas: 6th Rept. Ins. Ill. [1877], p. 96, f. 7 (description).
Lintner: in Count. Gent., xlvii, 1882, p. 645; in id., l, 1885, p. 623.
Dimmock: in Cassino's Stand. Nat. Hist., ii, 1884, p. 368, f. 427.
Johnson: in Bull. No. 4, Divis. Entomol., U. S. Dept. Agricul., 1884, p. 78.
Henshaw: List Coleop. N. Amer., 1885, p. 93, No. 5886.
Smith: in Proc. Ent. Soc. Wash., i, 1888, p. 54 (its odor).
Atkinson: Bull. No. 4, Agricul. Exp. St. Univ. S. Car., 1889, p. 87 (its odor).
Webster: in Insect Life, ii, 1889, p. 89 (in Indiana).

The following communication, under date of August second, from a gentleman at Perrowville, Va., accompanied specimens of the above-named beetle. The reply made thereto in the *Country Gentleman* of

August 17, 1882, has been rewritten and extended in the present notice, in consideration of the particular interest attending the insect.

I send by mail to-day a box containing several specimens of a hideous and most offensive beetle which has recently begun its ravages in the ash trees on my lawn. Will you please tell me its name and character, and how to free our trees from its presence. The odor from these beetles is so offensive at night that it is disagreeable to sit in the open air. I learn that they also occur on the forest trees in our vicinity.

The beetle is the *Dynastes Tityus* of Linnæus, known under the popular names of "the spotted-horn-bug" and the "rhinoceros beetle"—each having reference to the large horns with which the male is armed — these horns being, as in many other species of Coleoptera, as notably in "the stag-beetle," a sexual feature.

An Odorous Insect.

The family of *Scarabæidæ*, to which this beetle belongs, contains many species which are noted for the disagreeable odor that they emit, but none have the penetration and pungency of this. Where a large number are congregated, the atmosphere in their vicinity would readily become quite unpleasant to the nostrils, for even the dead bodies of the half-dozen sent me, although occupying a place, as I am writing, upon an open piazza at a distance of several yards from me, and after having been exposed to the air throughout the night, have rendered their vicinity quite intolerable to some of the unscientific members of my family who have been sitting with me.

The remarkable offensiveness of this insect has often been commented on. Among other notices of it are the following:

Mr. J. B. Smith, in a paper read before the Entomological Society of Washington, September 2, 1886, on the peculiar odor emitted by these beetles, stated that they had during the season developed into a veritable pest. In two States, Virginia and Tennessee, they had been locally so abundant as to saturate the air with the penetrating stench. The local boards of health, especially that at Memphis, Tenn., disinfected all sorts of foul and suspected localities without success, and only by accident was the true source of the smell at last discovered.

Prof. G. F. Atkinson, Entomologist of the Agricultural Experiment Station of South Carolina, states in Bulletin No. 4 of the station for January 4, 1889: "In the summer of 1886 the beetle was so plentiful, feeding on the leaves of the ash in Raleigh, N. C., as to cause a disagreeable odor, which pervaded nearly the whole city. For some time it was thought to be due to uncleanliness in certain parts of the city, but was eventually traced to these beetles."

Description.

The beetle, although "horrid" in the eyes of the gentleman communicating it, is, to the entomologist, from its size, form, and ornamentation, a beautiful and attractive specimen of the Coleoptera. It is, perhaps, the largest of our United States beetles. The maximum size of the males before me (not the largest that occurs) is two and one-half inches in length (three and one-half inches with legs extended), one and one-tenth inch across the abdomen, and eight-tenths of an inch in thickness of body. The female has the general form of the much smaller grapevine beetle, *Pelidnota punctata.* The male has quite a different aspect, being armed anteriorly with two stout black horns of a half-inch or more in length, of which the upper is a straight projection of the anterior part of the thorax, curving slightly toward its notched tip, and bearing stiff yellow hairs beneath; the lower one on the crown of the head curves upward to meet the other. On each side of, and near to, the thoracic horn is a black, short, sharp-pointed horn or spine. The thorax and wing-covers are of a pale olive-brown, the latter dotted irregularly with black spots of various sizes and shapes, of which some may be ocellated. Beneath, the abdomen is black. The legs are shining black, strong, and armed with stout spines and bristles. Fig. 26 represents the male as seen from above, and Fig. 27 as seen from the side.

Fig. 26.—The Rhinoceros beetle, Dynastes Tityus, male.

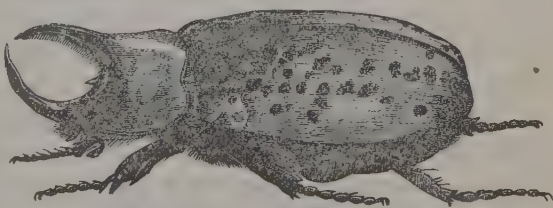

Fig. 27.—Side view of the Rhinoceros beetle.

Variation.—Much variation is presented in the colors and markings of these beetles, and particularly in the females. One example in my collection has the thorax black, while in another both the thorax and the wing-covers are very dark brown. A male before me has the

thorax of the normal color, while the elytra are dark brown, slightly mottled with paler brown. The females have the thorax delicately punctured (smooth in the other sex), with the wing-covers strongly punctured.

Distribution.

This beetle is quite abundant locally, at times, in most of the Southern States. To the west of the Mississippi, it occurs in Arizona, Kansas, Missouri, etc. It is found in Pennsylvania, but rarely. Dr. Fitch, in his *Third Report on the Insects of New York*, notices it as infesting the cherry (presumably in New York), but if taken within the State, it must have been in its southern portions.

Food of the Insect.

This insect has not been numbered among our insect pests, since its food has generally been supposed to be confined to decaying vegetable matter. The larva, probably, subsists only on material of this nature, which is a fortunate circumstance, for from its large size, attaining, it is said, four inches in length and a large diameter, it would be capable of inflicting most serious injury if it burrowed within the roots or trunks of living trees.

It has frequently been found (either as larva or imago) in cavities of dead or dying trees, as the cherry, willow, oak, etc., buried within the black vegetable material there accumulated.

The beetle, however, seems capable of injuries of considerable importance. Mr. J. W. Murrell, of Perrowville, Va., has informed me that, on the thirtieth of June, numbers of the beetle were feeding on the tender shoots of the spring growth of ash trees, causing the leaves to fall and cover the ground as if a frost had passed over them.

Request made of Mr. Murrell for additional observations on the feeding and other habits of the beetle was promptly complied with, in the following interesting communication received from his son, Mr. G. E. Murrell, of Coffe, Va.

Among the trees on my father's lawn are twenty of ash, to six of which my observations have been mostly directed, as they have been infested yearly for some time past. These are in different parts of the lawn, between other ash trees, and are the same in health and otherwise as those not attacked. I have first seen the beetles coming out of the ground at the roots of the trees, with one exception, which was four years ago, when I dug them out of a decayed fork of a mulberry, on which no trace of them has since been seen.

When feeding on the ash, they place themselves longitudinally on a smooth limb, and, rising to the full extent of their legs, move their entire body backward and forward like a plane, using several chisel-like projections on the under-side of the head for cutting, stopping the

motion as soon as the alburnum is reached, and never using their horns, so far as I can see, except for fighting. They breed below ground, to the best of my observation.

A neighbor says that he has been troubled with them on his tobacco, to which they are extremely fatal — no plant once attacked ever surviving.

The method of feeding on the bark of the ash, as above given, is an interesting item in the habits of the beetle, but it leaves us desirous of further information as to whether it prefers the bark to the leaves, and if it consumes, harmlessly, only the outer bark, or injuriously, also, the alburnum beneath. Does the larva, in its growth within the ground, subsist only on decaying vegetable matter, or in part on the rootlets of the trees?

The nature of the attack on tobacco — in what manner and to what extent it feeds upon it — would also be of much interest toward a fuller knowledge of this large insect.

Remedies.

When attacking, to a harmful extent, shade or ornamental trees, or when the offensive odor becomes intolerable, the beetles may be destroyed by the application of an arsenite to the foliage, or by jarring or beating them from the branches and dropping them in hot water.

Oberea bimaculata (Oliv.).

The Raspberry-cane Girdler.

(Ord. Coleoptera: Fam. Cerambycidæ.)

Saperda tripunctata Fabricius: Ent. Syst., i, pt. ii, 1792, p. 310, No. 15; Syst. Eleuth., ii, 1801, p. 321.

Saperda bimaculata Olivier: Entomologie, iv, 1795, 68, p. 21, pl. 4, f. 43.

Saperda affinis Harris: Rept. Ins. Mass., 1841, p. 91.

Oberea tripunctata Haldeman: in Trans. Amer. Philosoph. Soc., x, 1847, p. 57.

Oberea perspicillata Haldeman: in loc. cit. sup., p. 57.

Oberea tripunctata. LeConte: in Journ. Acad. Nat. Sci. Phila., 1852, p. 153.

Oberea basalis LeConte: in loc. cit. sup., p. 153.

Saperda (*Oberea*) *tripunctata* Harris: Ins. New Engl., 1852, p. 100; Ins. Inj. Veg., 1862, p. 114, f. 51.

Saperda tripunctata. Emmons: in Nat. Hist. N.Y.—Agricul., v, 1854, p. 122, pl. 16, f. 7.

Oberea tripunctata. Glover: in Rept. Comm. Agricul. for 1863, p. 576.

Oberea tripunctata. Saunders: in Rept. Ent. Soc. Ont. for 1873, p. 8–9; Ins. Inj. Fruits, 1883, p. 305–6, f. 315 (*O. bimaculata*).

Oberea tripunctata. Lintner: in Count. Gent., xxxix, 1874, p. 487.

Oberea perspicillata. Riley: 6th Rept. Ins. Mo., 1874, p. 111 (quotes Provancher).
Oberea tripunctata. Provancher: Pet. Faun. Entomolog. Can., 1877, p. 636.
Oberea bimaculata. Horn: in Trans. Amer. Ent. Soc., vii, 1878, pp. 46, 48.
Oberea bimaculata. Henshaw: List Coleop. N. Amer., 1885, p. 104, No. 6496.

An insect attack on the new shoots of the raspberry which is often the occasion of inquiry, is that which attends the oviposition of the raspberry-cane borer. The following is received from Potsdam, N. Y.:

You will find herewith a small vial containing an insect and three pieces of canes of Brinckle's Orange raspberry. You will see the two rings that are made in the canes between which an egg is deposited — usually in the center, but not always. Can you give me the name of the creature which is causing so much mischief; and what shall we do to prevent the destruction of our raspberries?

Synonymy of the Insect.

The author of the mischief above described is a longicorn beetle having the scientific name of *Oberea bimaculata*. As may be seen above, it was given the name of *Saperda bimaculata* by Olivier in 1795. It had been previously named by Fabricius as *tripunctata*, from the three black spots that its thorax frequently bears, and it was for a long time, and until quite recently, known under the Fabrician name. When it was found, however, that the name had been preoccupied in the same genus by a species by Swederus occurring also in the United States, it was necessarily abandoned for that given it somewhat later by Olivier. Of the other specific names, that bestowed on it by Dr. LeConte, *basilis*, was based on examples in which the entire basal margin of the thorax is black; and *perspicillata* of Haldeman, on smaller forms showing some other features not of specific importance.

Description of the Beetle.

Fig. 28. — The raspberry-cane borer, Oberea bimaculata.

The beetle is of a slender cylindrical form, about a half-inch in length, with delicate antennæ nearly as long as the body and tapering slightly toward the tip. It is of a deep black color except the forepart of the breast and top of the thorax which are rusty-yellow. There are two black elevated dots on the middle of the thorax (sometimes absent) and a third dot (usually) on its hinder border. The wing-covers are closely punctured in the rows, and irregularly on the sides and tips — each of the latter slightly notched and ending in two little points.

The Cane-girdling.

The two rings referred to in the communication consist of closely placed punctures which are made by the mandibles of the beetle around the stem not far from its tip; the distance between the rings ranges from half an inch to one inch. As soon as these punctures are made — usually in the month of June — the portion of the cane above the upper girdling commences to wither and droop, to shrivel and die, when it is easily broken off by the wind.

It is supposed that the purpose served by the girdling is the arrest of the circulation of the cane in the portion thus treated, to the extent that the tender egg deposited therein may not be crushed by the vigorous and rapid growth of the tips at just this season. A number of insects are apparently endued with an instinct that leads them to resort to some similar method for the preservation of their eggs in cases where a provision of the kind seems to be needed.

Summary of Life-history.

The egg, which is deposited by the beetle in the cane previous to the girdling, hatches in a few days and the grub therefrom burrows downward into the cane, feeding meanwhile upon the pith. It may be found full-grown a few inches down the stem about the first of September. It passes the winter within the stem (according to Riley, in the root beneath the surface of the ground), to emerge therefrom as the perfect beetle the following June.

The beetle unquestionably prefers the garden raspberry for oviposition, yet it is also to be found at times on the more tender canes of the blackberry. Professor Riley has observed its operations in cottonwood [*Populus monilifera*], and identified its oviposition in the twigs of persimmon [*Diospyros Virginiana*] from Saint Augustine, Florida.* A closely related species, *Oberea Schaumii*, oviposits in sassafras, according to Mr. Schwarz.

The *Oberea perspicillata* of Walsh and other writers is our raspberry-cane borer under a name given it by Haldeman in 1847, as cited.

Remedy.

It is seldom that this insect appears in sufficient number to be the occasion of serious injury. Its multiplication may be prevented by going over the bushes at intervals of a few days, during the period of its oviposition when the bent and wilted tips at once disclose the attack, and breaking off the egg-bearing tips at the lower ring. If these tips are destroyed, the unhatched eggs or the newly hatched larvæ will be destroyed with them, the larva not having at this time passed downward into the cane.

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* *Bulletin No.* 12, *Div. of Entomology, U. S. Dept. Agricul.*, 1886, p. 34.

Galeruca xanthomelæna (Schrank).

The Elm-leaf Beetle.

(Ord. Coleoptera: Fam. Chrysomelidæ.)

Linnæus: Syst. Nat., ii, 1767, p. 600, No. 101 (*Chrysomela Calmariensis.*)

Fabricius: Syst. Ent., 1775, p. 119, No. 4 (*Crioceris Calmariensis*); Spec. Ins., i, 1781, p. 150, No. 6; Mant. Ins., i, 1787, p. 87, No. 7; Ent. Syst., i, pt. ii, 1792, p. 23, No. 46 (*Galleruca Calmariensis*).

Schrank: Enumeratio Insectorum Austriæ indigenorum, 1781, p. 78.

Olivier: Encyc. Method.—Hist. Nat. Ins., vi, 1791, p. 589 (as *Galeruca calmariensis*).

Westwood: Introduc. Classif. Ins., 1839, p. 382 (destructiveness in Sevres).

Harris: Treat. Ins. N. Eng., 1852, p. 109; Ins. Inj. Veg., 1862, p. 124 (*Galeruca Cal.*).

Emmons: in Nat. Hist. N. Y.—Agricul., iv, 1854, p. 134, pl. 12, f. 12.

Fitch: in Trans. N. Y. St. Agr. Soc. for 1858, xviii, 1859, p. 842–3; 3d–5th Repts. Ins. N. Y. (5th Rept.), 1859, p. 62–3.

LeConte: in Proc. Acad. Nat. Sci. Phil. for 1865, p. 218 (features and references).

Glover: in Rept. Commis. Agr. for 1867, p. 62 (br. ref. and fig.); id. for 1870, p. 73.

Rathvon: in Field and Forest, ii. 1876, pp. 96–98 (at Lancaster, Pa.).

Riley: in Rept. Comm. Agricul. for 1878, p. 245 (br. ref.); in Amer. Entomol., iii, 1880, p. 291 (natural history, enemies, etc.); in Ann. Rept. Comm. Agricul. for 1883, pp. 159–170, pl. 12, f. 3 (full account); same, repub. as Bull. No. 6, U. S. Dept. Agricul., Divis. of Ent., 1885; same, in Bull. No. 10 id., 1887, pp. 8–22, figs. 1–6.

Fuller: in Amer. Entomol., iii, 1880, p. 3 (at Newburgh, N. Y.).

Lockwood: in Amer. Nat., xv, 1881, pp. 242–244 (hibernation); in Bull. No. 4, U. S. Dept. Agr., Div. Entomol., 1884, p. 90 (ravages at Freehold, N. J.).

Packard: Ins. Inj. For.-Sh. Trees, in Bull. No. 7, U. S. Ent. Commis., 1881, p. 64 (brief description).

Lintner: in Count. Gent., xlvii, 1882, p. 805; id., l. 1885, p. 841 (remedies, etc.); in Canad. Entomol., xvi, 1884, p. 183 (reference); in Count. Gent., li, 1886, p. 409 (bibliography, etc.): lii, 1887, pp. 421, 565, 695 (spraying for); 4th Rept. Ins. N. Y., 1888, pp. 15, 143, 161, fig. 59 (extension of range).

Van Wagenen: in Canad. Entomol., xv, 1883, p. 160 (abundance at Cold Spring, N. Y.).

Clarkson: in Canad. Entomol., xvi, 1884, p. 124 (at Flatbush, L. I.).

Henshaw: in Cassino's Stand. Nat. Hist., ii, 1884, p. 316 (its enemies, etc.); List Coleop. N. Amer., 1885, p. 111, No. 6912.

Cook: in Rur. N. Yorker, xlv, 1886, p. 577 (general notice).

Dyar: in Insect Life, i, 1889, p. 285 (at Poughkeepsie).

This destructive insect pest, which within the last few years has extended its ravages into the State of New York, entering it from the south and spreading northward with a steady progress that threatens to carry it to the northern borders of the State, and even beyond, is one of the many injurious species which Europe has contributed to

us. Its great destructiveness wherever it has established itself among us, is one of the many attestations to the often-made statement, that by far the larger number of our more injurious insect pests have been introduced from Europe.

Belongs to the Chrysomelidæ.

It belongs to the *Chrysomelidæ,* that large family of very bad reputation on account of their leaf-eating habits. The beetle is a small, yellow-legged, brown insect, having a broad dull-black stripe

FIG. 29.— The Elm-leaf Beetle, GALERUCA XANTHOMELÆNA, in its different stages.

on each wing-cover toward its outer margin, and three black spots upon the ochreous thorax. In size and general appearance it resembles another well-known member of the family — the striped cucumber beetle, *Diabrotica vittata* (Fabr.). The insect has been so often described in its egg, larval and perfect stages in the Reports and Bulletins of the Entomological Division of the Department of Agriculture, that it does not seem desirable to repeat the details here. Those who may desire detailed descriptions for the purpose of identification or for scientific use, are referred to these publications or to some other of those included in the bibliographical list accompanying this notice.

The figure above given, illustrative of the insect in its several stages, which was presented in our fourth report and is herewith

repeated, should suffice for its recognition when met with upon the elm. In it, *a*, shows the eggs as they are deposited in clusters on the leaf; *b*, the larvæ; *c*, the beetle in natural size; *e*, the eggs enlarged; *f*, their sculpture under a high magnifying power; *g*, the larva in about twice its natural size; *h*, a side view of the segment of the larva; *i*, dorsal view of the same; *j* and *k*, the pupa and the beetle enlarged; *l*, a portion of the wing-cover of the beetle enlarged.

Its European Reputation.

This species has long been known as, at times, quite injurious to the foliage of elms in Europe, but it nowhere appears to have occasioned even an approach to the amount of harm that it has in this country. Linnæus wrote of it over a century ago, in 1767, and named it *Chrysomela Calmariensis*, from its occurrence in Calmaria, a small sea-port town in Sweden.

Introduction in the United States.

It was introduced in this country, according to Glover, as early as the year 1837, but probably several years earlier than this, for it is recorded that in 1838 and 1839, elms in Baltimore and the vicinity were entirely stripped of their leaves in midsummer, and when new leaves had again put forth, these were also destroyed by a second brood of the grubs. Such a degree of multiplication could not have taken place in less time than six or eight years.

Its Ravages.

It has proved very destructive in the District of Columbia, in various portions of New Jersey, and in Pennsylvania. Later, it made its appearance upon the elms in thé State of New York, and has wrought great havoc among them.

In 1879, it appeared in immense numbers at Newburgh, N. Y., and almost entirely stripped the foliage from the elms that it attacked. (*American Entomologist*, iii, 1880, p. 3.)

The *New York Daily Tribune*, of July 8, 1884, contained the following picture of the destructions caused by this insect on Long Island:

Work of Elm-tree Beetles.— Flushing, L. I., is suffering from an insect plague which bids fair to mar the renowned arborial beauties of the village. A few days ago it was noticed that the leaves on several stately trees in Main street were withering. A more careful examination resulted in the discovery that the trees were covered from trunk to topmost branch with little worms about half an inch long. On the ground under the trees were thousands of dead insects which had been blown off and trodden upon by pedestrians, making a most disgusting sight. All the trees in every part of the village are being

slowly ruined by these insects. They are what are known as elm-tree beetles, but they do not confine their presence to elm trees. A number of attempts have been made to destroy them, but without success. It is said that in a communication sent to the Commissioner of Agriculture in Washington last year by a distinguished naturalist, he gave it as the result of his experiments that there was no means of exterminating the beetles. All sorts of insect powders have been used by the residents, but in vain. The village streets present such a plague-stricken appearance that the trustees will probably order some of the trees to be cut down to prevent the pestilence from spreading.

Mr. James Angus has written me of the ravages of the insect as observed by him near Throggs Neck, Westchester county, N. Y., on the 24th of August, 1883. A row of elm trees bordering the road had been entirely defoliated by it. "Incredible as it may seem, there was not a green leaf on any of the trees, except that upon some limbs a second growth had commenced. The leaves had been attacked rose-slug fashion, and every tree looked as badly as the worst slug-eaten rose-bush that I had ever seen." Writing the following year, under date of May thirty-first, he stated: "I visited to-day the place where the insect was so destructive last year, and found that the elms were eaten far worse than ever before. A gardener informed me that the leaves had been stripped three times during the preceding year. He showed me two trees that had been killed, and others of which most of the outer limbs were dead."

Life-history, as Given by Glover.

The habits and transformations of this insect were concisely and correctly given, and with such a degree of fullness as to leave but little to be added, by Mr. Glover, Entomologist of the U. S. Department of Agriculture, in the *Report of the Commissioner of Agriculture* for the year 1867 (pp. 62–63, with figures). We therefore quote the following from the report named:

The insect deposits its eggs in clusters upon the leaves, the worms or larvæ from which are hatched out in a few days, and immediately commence to feed upon the parenchyma or soft pulpy substance of the leaf, at first making merely small blotches, but eventually, as they increase in size, destroying the whole leaf, leaving only the harder part, such as the midribs and network of veins untouched, thus causing the leaves to turn brown and wither, until the whole tree assumes the appearance of having been scorched by fire. These worms, when fully grown and ready to change to pupæ, not being able to descend by means of a silken thread, like the real caterpillar, crawl down the trunk to the ground; and soon casting their larva skin, change into pupæ on or near the surface of the earth, at the foot of the tree they have despoiled. Some of the worms, however, conceal themselves in

fissures of the bark, where they undergo their transformations into the perfect beetle. These last, however, are few, and bear no comparison with the multitudes of the pupæ which will be found on the damp ground, motionless, helpless, and appearing like grains of wheat accidentally fallen near the tree. After becoming pupæ, in a few days the skin of the back splits open, and the perfect insect crawls forth, furnished with wings, by means of which it is enabled to fly to other trees to deposit its eggs, thus spreading the nuisance to every elm in the neighborhood, or it may ascend the same tree and lay the eggs for the second generation, which destroys the second crop of leaves, frequently so enfeebling the already exhausted tree that it is unable to recover, and eventually dies.

Hibernation of the Beetle.

To the above comprehensive account of Mr. Glover may be added a few additional observations on the life-history of the insect for the benefit of those who may desire as full a history as may be given, in order that they may be the better prepared to meet it in its several stages of transformation.

The insect hibernates in the beetle stage. Members of the last brood (in the State of New York we have two broods a year *) — those that have survived the dangers to which they are exposed — quite early in the season (time not definitely known) seek such sheltered places as may offer them fitting quarters for their winter's sleep. Many enter out-buildings and dwellings for their hibernation, for each spring examples of the beetle, found within doors, and usually in unoccupied apartments, are sent for name and other information, their numbers having drawn attention to them as unknown guests. Mr. Angus, of West Farms, New York, has informed me that a neighbor, whose house was overtopped with two large elms, and had been closed for some time during the summer, upon his return, found the beetle in large numbers lying about everywhere. They had entered the house through the crevices in the shingled roof, and through the chimneys.

The time of the emergence of the beetle from its winter's retreat will vary, of course, with the degree of forwardness of vegetation, but it will be as early as the leaves of the elms are in condition to receive the eggs. On the 24th of April, 1884, Mr. Angus wrote me that it was then first making its appearance in the garret of his house.

* Although this has been generally accepted, Rev. Mr. Hulst and Prof. J. B. Smith, from careful observations made on the insect, as entomologists of the New Jersey Agricultural College Experiment Station, have reached the positive conclusion that for the last two years, at least, there has been but a single annual brood in that State. There may be, they think, a second brood in Washington, but not in New Jersey and to the northward.

A week later, he could send me any number for examination if desired. Writing again on the twenty-eighth inst., he stated, "the garrets of all the houses in the neighborhood where there are elms are full of them."

Oviposition.

It appears that both sexes hibernate, and that their union takes place in the spring, after they have flown to the elms and fed to a noticable degree on the new foliage. Leaves quite badly eaten by the hibernating beetles have been sent to me from Mr. Angus on the twenty-third of May, and on the thirty-first the beetles were reported as copulating and the females rapidly laying their eggs.

Pupation.

The pupation occurs in July. On the ninth of that month Mr. Angus wrote that the larvæ were then pupating in "handfuls" in the crevices of the bark at West Farms, A moderate amount of shelter satisfies the larva, and it accordingly assumes its pupal state under any convenient crevice offered it as between the base of the tree and the ground surrounding it, in crevices between the bricks of a side-walk, beneath stones or any other object lying on the ground. The beetles make their reappearance after a very brief pupation, rarely exceeding ten days.* Riley has recorded pupation at Washington on July twenty-ninth, which may have been of the third brood.

Remedies.

The most effectual remedy for the ravages of this insect is believed to be spraying the foliage of the infested elms with Paris green or London purple in water. Of these, London purple has been found, through careful experiments made, to answer the purpose the better. Its efficiency will of course depend upon its method of application — the apparatus used, the liquid and the time applied. A suitable force-pump is essential to success. It should have sufficient power to carry the liquid to a good distance and distribute it over a broad area. The nozzle for its distribution should be an atomizer, or the finest of the "Nixon nozzles," made at Dayton, O., or one of the several "graduating spray nozzles" which are in market. The nearer the spray can be made to approach a mist the more effectually will it be spread over the foliage, with the least expenditure of material and with the least injury to the leaves.

If the spray is to be applied to tall and large trees, from the ground or from a wagon, a long rubber hose will be needed having the

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* See foot-note on preceding page for qualification of this statement.

nozzle at its end, and tied, for convenience of elevation, to a long bamboo or other light rod. If the highest portion of the tree may not be reached in this manner, a portable spraying apparatus holding four or five gallons, such as is advertised and illustrated in some of the agricultural journals, may be strapped upon the back, and, ascending the tree with a ladder, the spray distributed from its principal limbs.

The proportion of London purple to be used would be one pound to 200 gallons of water. To the above eight quarts of flour might be advantageously added, the effect of which would be to cause the arsenite to adhere better to the leaves and prolong its usefulness.

It is quite important that the spraying should be done early — even before the first traces of injury to the foliage are discovered — as soon as examination shows that the eggs of the beetle are being deposited on the leaves, usually on the under side. They can readily be seen, as they are of a yellow color, oblong-oval in form, and placed on end — sometimes but two or three together, but more often in clusters of from ten to twenty. By early spraying, a less strength of the arsenite is needed to poison the young larva as soon as it hatches from the egg, and the foliage is less liable to sustain injury, as there will be at the time no eaten and raw edges of the leaves to absorb the poison rapidly, and thereby causing greater harm.

If the spraying be properly done at the right time, it should not be necessary to repeat it, unless a heavy rain occurs very soon thereafter. If the foliage shows continued depredations, a second spraying should follow in ten days or a fortnight.

Sulphur for the Elm Beetle.*

W. H. Dodd, of Orange, N. J., says that he has demonstrated to his satisfaction that the annual attack of the elm beetle upon elm trees in this country can be thwarted by an extremely simple and inexpensive process. He addressed a meeting of interested citizens in Bloomfield on Tuesday night, and described the plan which he used last year, not only upon a large elm, but upon fruit trees which were infested with insect pests of various kinds. He says that in the early spring he bores one-inch auger holes, five inches apart and in a circle around the trunk of the tree, about eighteen inches from the ground, taking care that the holes do not penetrate beyond the sap-wood of the tree. Then he fills the holes with flowers of sulphur or powdered brimstone, and loosely plugs them up. He says that the plan worked to perfection last year. His idea seemed to be that the sap took up the sulphur and carried it into the leaves, making them distasteful to the worms which hatch out on the under side of the leaves from the eggs deposited there by the beetles. The plan involved little trouble or expense.—*New York Sun.*

* Communicated, by request, to the *Country Gentleman* of March 15, 1888.

Repeated experiments have failed to show any benefit from the use of the above reputed remedy for insect attack on the foliage of fruit or other trees. It seems to have been first announced sixty-six years ago in the *Memoirs of the* [old] *New York Board of Agriculture* (vol. ii, page 250, by George Webster, of Albany, who, after having bored holes six inches deep in his infested trees, which he filled with sulphur and tightly plugged, found that all the caterpillars disappeared within a day or two thereafter. Others who tried the experiment had the same result. This was, perhaps naturally, ascribed to the sulphur, when, in fact, the larvæ had matured and left the trees to find suitable places for pupation.

Mr. Dodd, the latest propagator of the old remedy, claims that the sap takes up the sulphur, carries it into the leaves and makes them distasteful for food. This can not be true. Sulphur can not enter into circulation, unless it be first dissolved, and we know that it is not dissolvable by the sap of plants or trees. Mr. Isaac Wicks, of New York, having placed a quantity in some peach trees as a remedy for the yellows, on cutting up the trees five years thereafter, found it still remaining in the cavities in its original condition (*Practical Entomologist*, i, 1865, p. 125).

Nor is there any reason to believe that if the sulphur could be carried into the sap, the leaves would thereby become distasteful or injurious to the caterpillars. Among the various articles experimented with in France in search of some remedy against that terrible scourge of the vineyards, Phylloxera, sulphur was tested, but without any effect either upon the leaf or root insects, although these are almost microscopic and exceedingly delicate creatures.

Experiments made by Dr. Fitch prove conclusively that sulphur is not injurious to the apple-tree tent-caterpillar. A limb of a wild cherry tree having on it a nest of these caterpillars which were only one-fourth of an inch long, was cut off and placed in a cup of sulphur slightly moistened with water — a more severe test than if the material had been inserted in the branch. A limb containing another nest was placed beside it in a cup with water only. At the end of nine days the caterpillars of the last-named nest measured four-tenths of an inch long, while the others had grown to double the size, measuring from 0.8 to 0.85 inch. The experiment seemed to show that so far from the sulphur having been injurious to them, it had rendered them more healthy and robust, and accelerated their growth. (*First and Second Reports on the Insects of New York*, 1856, p. 203.)

It seems a great pity that something as simple as the "sulphur cure" can not be found available against the elm-leaf beetle, but until such a discovery shall be made, we shall have to hold fast to the well-tested and efficient method of spraying with Paris green or London purple, with a suitable force-pump, and a sufficient length of hose furnished with an atomizing nozzle; or, later, to cage the mature larvæ for destruction in a box, tarred within and on the bottom, placed around the tree trunk, when they descend the tree for pupation in the ground.

The Box Remedy.

The box, above mentioned, was suggested by Mr. Glover, in his Annual Report as Entomologist to the U. S. Department of Agriculture for the year 1867:

Place around each tree a low open box or frame about a foot or eighteen inches in height, at about the same distance from the main trunk, its lower part sunk four or five inches below the surface of the soil, the top capped with strips of bright tin sloping inwards and projecting on both sides like the eaves of a house, and the upper half of the inside boards painted every morning with coal tar or some other viscid substance. The earth within should be covered with cement. It being the habit of the larvæ when full grown to crawl down the trunk of the tree, they would, upon their descent, be imprisoned within the frames, being unable to escape either by entering the ground, or crawling outside over the tar and the projecting tin. They would therefore be compelled to change to pupæ within the frames, where they could at any time easily be killed by hot water or otherwise, by thousands. The frames should be made so as to be readily taken apart and laid aside at the close of the attack, until they are again needed.

Mr. Glover remarks that the same box might also be used for preventing the female canker worm, *Anisopteryx vernata* (Peck) from ascending the elms and fruit trees for the deposit of her eggs; but in that case, the tar should be applied to the outside of the box.

Clastoptera obtusa (Say).

The Alder Spittle-Insect.

(Ord. Hemiptera: Subord. Homoptera: Fam. Cercopidæ.)

Cercopis obtusa Say: in Jour. Acad. Nat. Sci. Phila., iv, 1825, p. 339; Compl. Writ., Lec. Edit., ii, 1883, p. 256.

Clastoptera obtusa Fitch: in 4th Rept. N. Y. St. Cab. Nat. Hist., 1851, p. 53.—Uhler: in Cassino's Stand. Nat. Hist., ii, 1884, p. 244.—Comstock: Introduc. Entomol., 1888, p. 178.—Provancher: Pet. Faun. Ent. Can.—Hemip., 1889, p. 259.

Its Spittle Observed.

The peculiar frothy masses of the secretion of a spittle-insect were observed on June twenty-seventh, in a large clump of alders, *Alnus serrulata*, at West Albany, N. Y. On every bush of even moderate size hundreds of the masses were clinging. They were believed to be the *Clastoptera obtusa* of Say, which Uhler represents as common on the black alder in July. The larvæ within the secretion may have been at this time half-grown.

Observations on the Insect.

On the seventh of July the locality was revisited for further observation. The perfect insect had made its appearance, and fifteen examples of it were secured. It proved to be, as was expected, *Clastoptera obtusa*. The species had developed unequally, for the spittle masses were still abundant — some containing the larvæ and others the pupæ. Twigs bearing the secretion were collected. When placed in a box for rearing, if possible, the immature insects all left their coverings and traveled over the box within, escaping from beneath a not very close-fitting lid. The larvæ were nearly white. Their legs were long in proportion to the size of the body and were moved rapidly in walking. The pupæ, which had but recently undergone their transformation, show but little coloring, especially on their wing-pads. With increased age they become more deeply colored, and are olive-green on their thorax, wing-cases and legs. The thin, transparent cases from which the larvæ had emerged were adhering to the stems and leaves of the alders.

The Spittle Mass.

C. obtusa belongs to a group of Hemipterous insects, known as "spittle-insects," from the frothy, liquid mass, resembling human spittle, in which the larvæ and the pupæ live concealed. These insects derive their sustenance from the stem or plant or grass upon which they are found, by sucking the juices through the proboscis with which all of the Hemiptera are provided in place of the cutting jaws or mandibles of most of the other orders. The excess of the sap beyond what is needed for their sustenance, is thrown out to form the "spittle" mass, which is often so abundant as to fall to the ground in drops of clear liquid when the imprisoned air has escaped from it.

How the Spittle-mass is Produced.

There seems to be a question as to the manner in which the frothy matter is produced. Mr. Uhler, our authority in the Hemiptera, in Cassino's *Standard Natural History* has stated: "The larvæ live covered by masses of white froth, which the insect produces by expelling from its beak the juices drawn out of the tree." DeGeer, the dis-

tinguished Swedish naturalist, has given an elaborate account of the observations made by him on the method of the spittle production. Wishing to obtain definite knowledge in relation to it, he removed one of the insects from its frothy coverings, wiped it dry with a camel's-hair pencil, and placed it on a freshly cut stalk of honeysuckle in a glass of water. The following is his account of what he saw:

It begins by fixing itself on a certain part of the stalk, in which it inserts the end of its trunk, and remains there for a long time in the same attitude, occupied in sucking and filling itself with the sap, Having then withdrawn its trunk, it remains there, or else places itself on a leaf, where after different reiterated movements of its abdomen. which it raises and lowers and turns on all sides, one may see coming out of the hinder part of its body a little ball of liquid, which it causes to slip along, bending it under its body. Beginning the same movements again, it is not long in producing a second globule of the liquid, filled with air like the first, which it places side by side with, and close to the preceding one, and continues the same operation so long as there is any sap left in its body. It is very soon covered with a number of small globules, which, coming out of its body one after the other, tend toward the front part, aided in this by the movement of its abdomen. It is all these globules collected together which form a white and extremely fine froth, the viscosity of which keeps the air shut up in the globules and prevents its froth from easily evaporating. If the sap which the larva has drawn from the plant is exhausted before it feels itself sufficiently covered with froth, it begins to suck afresh, until it has drawn a new and sufficient quantity of liquid, which it takes care to add to its first stock. (*Memoires pour servir a l'Histoire des Insectes*, Tome 3.)

In another place DeGeer makes this positive statement: "The globules have absolutely no other issue than from the anus."

Purpose of the Secretion.

As to the purpose served by this liquid covering, it has been conjectured that it has the effect of protecting the delicate-skinned insect from the burning heat of the sun, for it can not live long if withdrawn from it, for the insect soon shrinks and speedily dies. It is thought also that the covering protects it from carnivorous insects and other enemies, that but for this concealment would prey upon it. It does not, however, give it entire immunity, for some of the larvæ collected by me at West Albany had been visited with a parasitic attack, and several Chrysopa larvæ were found in such association with the spittle masses that they were undoubtedly preying upon the insects concealed within.

Description of the Insect.

Uhler has briefly characterized it as of a claret-brown color above, marked with two pale bands on the vertex, two on the prothorax, and a wavy, broader band on the wing-covers. The membrane is often

whitish, the waved band is extended exteriorly, and there is a pale v-shaped figure on the end of the scutellum. It is a little larger than *Clastoptera Proteus*, a very common species, living on cranberry and blueberry bushes in swampy places throughout the Eastern United States.

It inhabits Canada, many parts of the eastern side of the United States, and is distributed southwest into Texas, and Tamaulipas, Mexico (Uhler).

Say (*loc. cit.*) has given a more detailed description of the insect, but the above should serve for its identification.

Some of the Spittle Insects.

There are a number of species of the insect which produce and live in this peculiar secretion, constituting the Hemipterous family of *Cercopidæ*, and occurring on various kinds of vegetation, as grasses, several of the weeds, on the grapevine, on willows, pines, etc. One of them, *Ptyelus lineatus* (Linn.), was briefly noticed and illustrated in the *Fourth Report of the Insects of New York*. The species more commonly met with belong to the genera of *Aphrophora* (meaning in the Greek, I bear froth), *Lepyronia*, and *Ptyelus*, meaning saliva. Of the first-named genus, the frothy envelope of the larval *Aphrophora parallela*, is often quite common on the white pine, and I have had drops from it fall upon me with unpleasant frequency when sitting under the branches, while pinning insect collections, in the month of June. *Aphrophora quadrinota* Say, and *A. Signoreti* Fitch, occur on the grapevine, and *A. quadrangularis* Say, on grasses, weeds and blackberry twigs. *Philænus spumaria* (*Cicada spumaria* of Linnæus), originally described from Northern Europe, also occurs in New York and is quite common in portions of New England.

Popular Names for the Insects.

The more common name for these froth-bearing tree-hoppers in the United States is "spittle-insects." In England the secretion is known as "cuckoo-spittle." The peasants of France know it by the same name, viz., *crachat de coucou*, and also by another, *ecume printaniere*, meaning "spring-froth." Another name that we may sometimes hear applied to it is "frog-spittle," having reference, probably, to its supposed origin. The negroes in Maryland, according to Glover, have a belief that the small forest-flies, so numerous in the woods, are produced from these frothy accumulations. In the final stage of these insects, from their habit of seeking safety in leaping when alarmed rather than in using the wings with which they are provided, they are known in common parlance as "tree-hoppers" and "frog-hoppers."

Their Injuries.

Report has been made in Vermont of one or more of the grass infesting species causing considerable damage to the hay crop. It was estimated that, in consequence of the depredations, the quantity of hay grown on some fields was one-third less than the natural yield, not including the depreciation in the quality of the crop. It is but seldom, however, that these insects increase to such an unusual extent as to become of serious injury, and it is therefore unnecessary to indicate any means for their destruction. A gentleman, who asks for information regarding them, states that, in passing through his mowing fields, in Auburn, Mass., they are so numerous as to wet his shoes. An abundance such as this would, of course, be harmful to the crop, but, fortunately, it is of rare occurrence.

Siphonophora avenæ (Fabr.).

The Grain Aphis.

(Ord. Hemiptera : Subord. Homoptera : Fam. Aphididæ.)

Aphis avenæ Fabricius : Syst. Ent., 1775, p. 736, No. 13; Sp. Ins., ii, 1781, p. 386, No. 18; Mant. Ins., 11, 1787, p. 316, No. 22 (name only); Ent. Syst., iv, 1794, p. 214, No. 22 (description); Syst. Rhyng., 1803, p. 297, No. 22 (name).

Aphis granaria Kirby : in Trans. Linn. Soc., iv, 1798, p. 238.

Aphis hordei Kyber : in Germar Mag. Ent., i, 1815, p. 11.

Aphis cerealis Kaltenbach : Mon. Fam. Pflanz., i, 1843, p. 16, No. 6.

Aphis granaria. Curtis : Farm Ins., 1860, p. 289, f. 39, pl. J. figs. 10, 13.

Aphis avenæ. Fitch : in Count. Gent., xviii, 1861, pp. 96, 114; in Trans. N. Y. St. Agr. Soc. for 1860, xx, 1861, pp. 833–840; in id., xxii, 1863, pp. 32–38; 6th Rept. Ins. N. Y. (6th–9th Repts.), pp. 91–98, pl. 1, figs, 5, 6.— Ashton : in Proc. Ent. Soc. Ph., i, 1862, p. 141.— Walsh : in id., p. 268.— Thomas : in Prairie Farmer, Jan. 18, 1862 : 8th Rept. Ins. Ill., 1879, pp. 51–55.—Bethune : in Rept. Ent. Soc. Ont. for 1871, p. 57–8, figs. 51–57.— Glover : in Rept. Commis. Agricul. for 1876, p. 36, f. 38.— Packard : in 9th Rept. Geolog.-Geograph. Surv. Terr., 1877, pp. 710–712.

Siphonophora granaria Buckton : Mon. Brit. Aphid., i, 1876, pp. 114–119, pl. 6 (descrip. habits, history, etc).— Riley–Monell : in Bull. U. S. Geolog.–Geograph. Surv. Terr., v. 1879, p. 19.

Aphis granaria. Ormerod : Rept. Inj. Ins. for 1879, p. 22; id. for 1882, p. 14; id. for 1884, p. 25; Manual Inj. Ins. [1881], pp. 63–65.

Siphonophora avenæ Lintner : in Count. Gent., xlvii, 1882, p. 493; in Rept. Reg. Univ. for 1886, pp. 112–114; in Trans. N. Y. St. Agricul. Soc., xxxiv, 1889, p. 105, f. 3 (as *granaria*).

Siphonophora avenæ. Webster : in Rept. Commiss. Agricul. for 1886, p. 576, (?· migration).

Nectarophora granaria Oestlund : in Bull. No. 4, Geolog.–Nat. Hist. Surv. Minn., 1887, p. 82.

The grain aphis owes its conceded claim to a place among the more injurious insect pests of the agriculturist, in consideration of the vegetation it attacks, its capability for harm, and its wide distribution. It is very generally distributed throughout the grain-producing regions of both continents. It infests all of the more valuable grain crops, as wheat, rye, barley, oats, and many of the other members of the grass family (*Gramineæ*). It is of common occurrence, being found in our fields nearly every year, but, like many other of the more destructive insects, it is only in certain years that, in particular localities, unknown conditions concur in causing its excessive multiplication, when its injuries are very great, even to the almost complete or the entire destruction of the crops attacked. Such an instance occurred in many of the Middle and Eastern States in the year 1861, when, as a new pest of the grain crops, it came under the observation of Dr. Fitch, who gave it careful study and contributed an excellent paper upon it, in his Sixth Report on the Insects of New York, first published in the Transactions of the New York State Agricultural Society for that year. In it are contained its European history, account of its first appearance in this country, description of its three forms, its propagation and habits, its parasitic and other enemies, etc. As this paper is accessible to most who may desire the information that it embodies, only a brief notice will be presented of the insect in this report.

Different forms of the Aphis.

Dr. Fitch observed four different forms of the insect through the season, viz.: 1st, the young louse or larva; 2d, the pupa; 3d, a wingless female; and 4th, the winged female. The last two of these are shown in the accompanying figures.

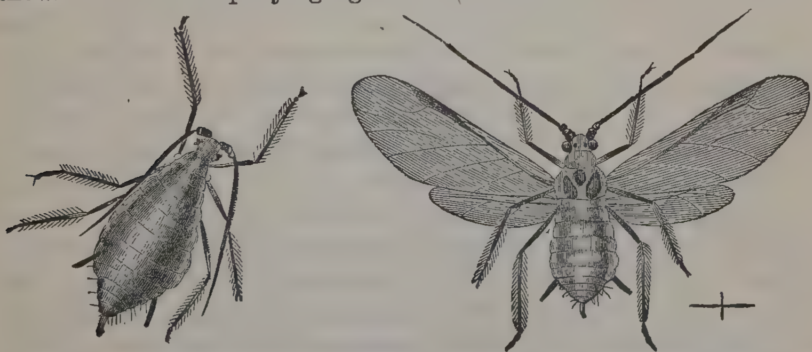

Fig. 30.—Wingless and winged females of the grain aphis, Siphonophora avenæ. (After Fitch.)

The wingless female is described as varying remarkably in color, being either red, green, brown, or yellow. The front is convex in the

middle with a distinct lobe on each side; antennæ black, nearly as long or longer than the body; knees, tarsi (feet), and tips of the tibiæ (shanks), black. The honey-tubes are shining brown, long, and thickened at the base.* The tail large, yellow and recurvel. The winged females, according to Buckton, are generally pale brown or rust-yellow; thorax brown; abdomen ovate, broad and shining green; honey-tubes black; antennæ longer than the body; frontal tubercles not large; legs ochreous, with black knees and feet; tail yellow, ensiform, and hairy.

Dr. Fitch has presented a detailed description of the winged form, which should be consulted. It differs in some particulars from the above, as, for example: The thorax is pale yellow, shining, with a large egg-shaped black or brown spot on each side; abdomen broad oval, grass-green, with a row of three blackish dots on each side; antennæ about equaling the body in length; legs with pale-greenish thighs, becoming yellowish toward their middle, and with dull yellow and black-tipped shanks.

The winged female was observed by Dr. Fitch to be less prolific than the wingless. Inclosed in separate vials, the former uniformly gave birth to two young in a single night, while the latter produced four in the same time. The winged ones were also much slower in coming to maturity.

Method of Attack.

As in other Aphides, its injuries are inflicted by means of its beak or proboscis, which it inserts in the plant for sucking the juices. This beak, which is folded under the breast when not in use, is pale green, black-tipped, and is given out from between the base of the forelegs and reaches half-way to the middle legs. The insect may be first observed early in the season, during the month of May, feeding upon the stalks and leaves, usually on the under side of the blades. As soon as the heads of the grain make their appearance — ordinarily in the latter part of June in New York — deserting every other portion of the plant, all the individuals congregate thereon about the base of the forming kernels, each with its head downward, sometimes crowding together in clusters that nearly cover the head. A remarkable change, according to Dr. Fitch, now takes place in their color; while feeding on the coarser juices of the leaves and stalks they are all of a grass-green hue, but as soon as they change to the more delicate juices of the flowers they begin to assume an orange color. After awhile the orange in most of them inclines either to red or to yellow.

* Mr. Glover records a statement made to him, that although these honey-tubes are well developed, they emit no honey, and in consequence are not visited by ants.

This seasonal change of color, dependent upon the portion and condition of the plant that nourishes them, together with the particular food-plant on which they are observed, will fully explain the discrepancies in the colors assigned to them by different writers.

Abundance in the Year 1861.

Although a few individuals of this aphis had been observed sparsely distributed in grain fields in the State of New York and elsewhere, it had not been regarded as of any economic importance previous to the year 1861. Dr. Fitch knew of no recorded instance in which an aphis, although noted for rapid increase, had become thus suddenly and excessively multiplied over such a wide extent of territory. In the summer of 1861, throughout the greater portion of the New England States, the State of New York, except its western section, the north-eastern part of Pennsylvania, and in several localities in Canada, every grain field was invaded by it, and in most of them it abounded in incredible numbers. The yield of wheat was often reduced one-half, while the oat crop suffered still more severely, to the extent of hardly paying for the harvesting.

Not Usually very Injurious.

No demonstration of the insect has since occurred at all comparable with that above recorded. It continues, however, to make its appearance almost annually in considerable or in insignificant numbers. Examples of it are frequently sent to me with inquiries similar to the following, which came from Albemarle county in Virginia:

I send by this mail specimens of flies and aphides with which the wheat-heads all through this section are affected. You will confer a favor upon a large number of farmers in this county by giving the name and nature of these insects, and the information whether they will materially injure the crop.

To the above, after giving the name, habits, etc., of the insect, it was further stated:

"The injuries will be in proportion to their number and of the associated parasites. Heavy and long continued rains would be very serviceable in checking the attack. It is not probable that it will inflict severe injury to the wheat crop now attacked, for the kernels will soon have so far advanced and hardened as no longer to serve for food. Its numbers are, doubtless, being materially lessened by the parasites and other predaceous insects which are preying upon it, judging from the many dead aphids found in the package received. The specimen separately inclosed and marked 'for examination and name,' is the larva of a lady-bug, probably that of *Hippodamia con-*

vergens Guer., which has, doubtless, rendered excellent service in the destruction of the lice. A single one of these larvæ upon a head of wheat should, from its well-known voracity and remarkable appetite, entirely free it in a short time from aphis presence."

Different Names of the Insect.

Several names have been given to this insect, as may be seen in the partial bibliography given of it, since it was first brought to scientific notice, about a hundred years ago. It is the *Aphis avenœ* of Fabricius, Schrank, Walker and others of Europe; of Fitch, Thomas and most of our writers in the United States. Mr. Buckton, in his Monograph of British Aphides, vol. 1, 1876, designates it as *Aphis granaria*, adopting the name given it by Mr. Kirby in 1798, in a paper read before the Linnean Society, on the ground that Fabricius gave no description of his *Aphis avenœ.* In this he seems to have accepted without examination, the statement made by Curtis in his *Farm Insects*, viz., "as Fabricius has given no description of his *Aphis avenœ*, which is possibly the same species [with Kirby's], Mr. Kirby was constrained in describing it, to designate it by a new name." Both these gentlemen have very strangely, as was some time ago pointed out by Dr. Fitch, overlooked the description of Fabricius. In the earlier Fabrician writings — *Systema Entomologiœ* in 1775, *Species Insectorum* in 1781, and in *Mantissa Insectorum* in 1787, the species appears only by name, but in the *Entomologia Systematica* in 1794, it was sufficiently described to indicate beyond doubt the insect named; and that there need be no excuse for longer continuing the name of *granaria*, the description contained therein is herewith given :

Avenae. 22, A. Avenae sativae.
Habitat in Avena sativa.
Caput obscure testaceum antennis nigris. Thorax testaceus, antice viridis. Abdomen viride lituris marginalibus, nigris. Corniculi cylindrici, nigri. Anus terminatur stylo parvo, albo. Pedes nigri femoribus basi albis.

That Kirby's name, published four years later, may be seen to have no claim to priority or adoption for any reason whatever, we quote from the Transactions of the Linnean Society, for 1798:

A. granaria, viridis, cauda biseta, setis geniculisque pedum nigris.

Aphis avenæ. Fab. Sp. Ins., ii, p. 386, N. 17.
Gmel., i, pt. iv, p. 2206.
Caput flavidum uti antennarum articulus primus. *Oculi* nigri. *Abdomen* obovatum cauda aculeata. *Pedes* livida, tarsis geniculisque nigris.

As may be seen from the synonymy presented, Kyber, a distinguished anatomist and microscopist, who early in the present century, made valuable researches and discoveries in the Aphides, gave the name of *Aphis hordei* to the insect, from the barley on which he found it feeding. Later, Kaltenbach, another German naturalist named it *Aphis cerealis.* More recently, it has been transferred to the genus *Siphonophora,* in the division that seemed demanded of the *Aphidinæ* into separate tribes. Still later, another writer, Mr. Oestlund, in his *Synopsis of the Aphididæ of Minnesota*, has transferred all of the Siphonophoras to the genus *Nectarophora,* assigning as a reason for proposing to replace the familiar name of *Siphonophora,* that "as a generic term it was already appropriated for the Myriopoda before Koch made use of it in the *Aphididæ;* and it is also used to denote an order of the Oceanic Hydrozoa, and should, therefore, according to practice, be replaced by one not already occupied." This proposed change will not, we think, be accepted, until demanded by a code of laws regulating nomenclature that shall rule authoritatively.

Its Incomplete Life-history.

The life-history of the grain aphis is incomplete; the male sex, although a form was described by Curtis as such, is still unknown. The summer form is believed to have an autumnal migration to some other food-plant, as have many of the Aphides, yet it has never been observed. Mr. Walker has affirmed that this species migrates in autumn from the wheat to several kinds of grass.

Professor Webster has made some experiments toward ascertaining where the species passes the summer, or until the young wheat appears in the autumn. It was infesting the heads of barley in considerable numbers, and when the grain was fully ripe and the winged adults ready to forsake the barley heads, he transferred some of them to cages, in which growing timothy, blue grass, and red top had been transplanted. The grasses were kept alive, but the insects died, and no trace of a following generation was observed. (*Loc. cit.*)

Buckton had searched the roots of grain in September for its supposed underground habitat at that time, but fruitlessly; nor did he know what became of it during the winter. Since then, Dr. Thomas has been able to add somewhat to our previous sparse knowledge of its life. He found on wheat, in the winter of 1875, an aphis, which, although differing from the descriptions of Fitch and Curtis, he had no doubt was the same species, and he has written of it as follows:

"When the winter wheat appears above the ground in the fall, it passes from its hiding-place at this time, wherever that may be,

probably in the same way that it does from the winter wheat to the spring wheat and oats in the spring, that is, by the winged individuals. Here they work upon the leaves and stalks singly while the weather is not too cold, but when winter appears they move downward toward the ground, some of them, at least, entering the soil and feeding on the sap of the roots. At any rate, I find the apterous ones at this time working upon the roots, but at the same time I find a winged individual above ground.* I have observed them heretofore at the root of the wheat late in the winter, while snow was on the ground, and, what somewhat surprised me, I found them busy at work under the snow, and the apterous females bearing well-formed larvæ. I am, therefore, led to believe that in this latitude the species passes the winter in other than the egg state. This will probably be found true wherever winter wheat is grown."

The above will serve to show how much yet remains to be learned of the life-history of this species. A male unknown and no knowledge of an egg-laying female, should be a sufficient stimulus for its further study. Dr. Fitch has written of it: "I have watched the grain aphis this year [1862] round so closely that I am perfectly assured that no eggs were laid and no males were produced. When and under what circumstances males occur, if they ever do occur, is yet remaining to be discovered. At present it seems as if these insects might go on forever producing young without any intercourse of the sexes."

Is it possible that this species will be found to confirm a statement made by Kyber, a careful and skillful student of the *Aphididæ*, that certain species that feed on herbaceous plants which fruit early in the year and then wither, produce males and apterous oviparous females *in the middle of the summer?*

Its Food-plants.

The grain aphis is by no means confined to wheat, barley, and oats. Kaltenbach has enumerated as its food-plants *Secale cereale* (rye), *Triticum sativum, Avena fatua, Hordeum murinum, Bromus mollis* (soft chess), *Dactylis glomerata* (orchard-grass), *Holcus* and *Poa.* Walker has added *Glyceria fluitans* and *Polygonum persicaria.* Passerini records it on various species of sorghum in Europe, including *Sorghum saccharinum.* Mr. Oestlund has found it in Minnesota, on *Phalaris canariensis* (canary-grass) and on *Poa annua.*

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*See, in this connection, a statement made to Mr. Glover, which would seem to indicate an unusual degree of endurance of cold (although doubtless not to the extent reported), viz., that "they freeze on the stalks in winter and revive in the spring."

Remedies and Parasites.

The use of salt, of soot, of gas-lime and of several other substances has been proposed as remedies for this insect, but we are compelled to admit that no method has been discovered by which its formidable attack upon a grain crop can be arrested. Fortunately, in nearly every instance when it has abounded, it has been promptly met by hosts of parasites which have done their work so effectually* that if the attack was not at once checked, it was not repeated the second year, or if continued, then ceasing to be serious and soon brought to a close. It is the particular province of a group of ichneumon flies to feed internally on plant-lice and restrain materially their rapid and prodigious increase. They belong to the family of *Braconidæ* and to the subfamily of *Aphidiinæ* — its name indicating the close relationship to the Aphides that it bears. About fifty species of these have been described from the United States and Canada by the three authors who have given them particular study — Mr. Ashmead, Dr. Fitch, and l'Abbé Provancher. The two species that were bred by Dr. Fitch from the grain aphis were named by him *Praon avenaphis* and *Toxares triticaphis* — their hosts having occurred on oats and wheat. Curtis, in his *Farm Insects*, has described *Aphidius avenæ* and *Ephedrus plagiator* which he obtained from the grain aphis in England.† A single one of these parasites entirely fills the body of the aphis, causing it to swell into a globular form. The infested aphis, fastened to the plant, is indicated by this distended form, its sienna-brown color usually, and later by the round opening on the back through which the parasite has emerged.

Myzus cerasi (Fabr.).

The Cherry Aphis.

Ord. Hemiptera: Subord. Homoptera: Fam. Aphididæ.

Fabricius: Syst. Ent., 1775, p. 734.4; Spec. Ins., 1781, ii, p. 384.4; Mant. Ins., 1787, ii, p. 315, No. 6; Ent. Syst., iv, 1794, p. 211, No. 6 (*Aphis*).

Fitch: in Trans. N. Y. St. Agricul. Soc. for 1854, xiv, 1885, pp. 829–833, 836, 837; 1st Rept, Ins. N. Y., 1856, pp. 125–128, 132, 133 (*Aphis*).

Buckton: Mon. Brit. Aphides, i, 1876, p. 174, pl. 33, figs. 1–5 (*Myzus*).

Thomas: 8th Rept. Ins. Ill., 1879, p. 75-6 (*Myzus*).

Saunders: Ins. Inj. Fruits, 1883, p. 216–7.

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*Mr. Curtis has written: On some wheat which we examined not a single aphis had escaped the searching vigilance of its enemies, and the husks were spotted with innumerable black globules [the bodies of Aphids which had been parasitized by *Ephedrus*]. *Farm Insects*, 1860, p. 291.

†For notices of other species of *Aphidiinæ*, their oviposition, etc., see 1st *Report of Dr. Fitch on the Insects of New York*, 1856, pp. 134–138, and Buckton's *Monograph of British Aphides*, 1879, ii, pp. 151–153 (Aphidivorous Ichneumonidæ). For recent descriptions of many new species, see Ashmead, in *Proceed. U. S. Nat. Mus.*, 1888, pp. 656–671.

Although with no new observations to present upon this insect, the inquiries recently made from some of the eastern fruit districts in the State of New York, of means for preventing its injuries, call for information in regard to it, and the following is, therefore, accordingly presented, compiled from the writings of Dr. Fitch and other careful observers:

Myzus cerasi, the *Aphis cerasi* of Fabricius, is the common black aphis of the garden cherry, *Cerasus vulgaris* — long known as quite destructive to cherry trees in Europe, whence it has doubtless been introduced in this country. It is rare to find a tree that is wholly exempt from it, and it often occurs in such incredible numbers upon the underside of the leaves, that, completely covering them, it overflows upon the leaf-stalks, the ends of the tender twigs, and even upon the young fruit. The larger infested leaves do not curl but turn backward or roll slightly. The more tender leaves upon the delicate twigs being drained of their juices, shrivel and dry and die, as do also the tips of the twigs. To such prodigious extent does this species sometimes multiply, that a single young tree that had attained a height of ten feet, harbored, according to a calculation made by Dr. Fitch — by taking the average number on a single leaf, counting the leaves on a branch, and the branches on a tree — at least 12,000,000 of individuals.

Life-history.

Its life-history, according to Dr. Fitch, who had not observed its underground operations, is the following: It makes its appearance as soon as the leaves put forth in the spring, hatching from eggs deposited the preceding autumn. During the spring and summer, winged and wingless forms are found; nearly all are without wings, and all are females. They continue to produce living young throughout the summer, which, when hatched, are smaller and of a brighter color than when mature. They multiply with exceeding rapidity, so that by the middle of June, in New York, the trees are literally overrun with them. Toward the latter part of the month, they are often attacked so vigorously by the larvæ of Syrphus flies and the lady-bugs (*Coccinellidæ*) that their ravages are temporarily checked and their numbers greatly diminished. If apparently exterminated, new broods shortly appear and resume their work, but they are incapable of inflicting as serious harm upon the now mature foliage, as at their first advent. On the approach of cold weather, male aphides make their appearance, and eggs are deposited at the base of the buds and in the crevices of the bark for the continuation of the species another year.

Mr. Buckton has given but few items relating to the life-history of this species. He states that two swarms occur in the year with a certain interval, one in June and the other in October. During the latter period the male makes its appearance, which he had taken under the leaves of the garden cherry in company with oviparous females. Mr. Walker had taken the latter on October thirty-first.

Description.

The careful description given of the insect in its several stages, leaves but little to desire. For those who have not convenient access to the first report of Dr. Fitch, we condense from it, as follows:

The LARVÆ when newly born are about 0.03 long, of a dull white or pale yellow color, with transparent and colorless legs and antennæ. They are oblong-oval in form, with the opposite sides of their bodies parallel, and their transparent or slighly dusky nectaries not reaching to the tip. Later, they become broader across the abdomen and deeper yellow, with the tips of the antennæ and the feet dusky and the nectaries black. After molting they change to dull reddish-brown or chestnut colored, with black heads. The legs, antennæ, and nectaries are whitish transparent.

The WINGLESS FEMALES are 0.05 long, broadly egg-shaped, black and shining, with a tail slightly projecting, nectaries black and reaching to or beyond the tip; the antennæ are shorter than the body and whitish, their two short basal joints and the apical half, black; the beak whitish, black-tipped; the legs white, with the feet, tips of the shanks, and commonly the thighs, at least of the hind legs, except at their base, black. [Cauda long and black — Buckton.]

The PUPÆ are 0.06 in length, resembling the wingless females in color and the larvæ in form, but may be known by the rudiments of wings like vesicular scales of a white or pale green color; the nectaries equal the tip which has no tail-like appendage.

The WINGED FEMALES are 0.05 long, and 0.20 across the wings; of a deep black and shining color; abdomen nearly twice as broad as the thorax, egg-shaped, with an acute apex having a short conical tail-like appendage, the nectaries reaching to its base; antennæ black, and about three-fourths the length of the body; beak black or dusty with a black tip; the legs black with the shanks, except at their tips and the basal half of the thighs, white. The wings are transparent, their bases, outer margins and rib-vein, white, the remaining veins blackish with their bases pale; the stigma opaque, dull white with black margins.

Food-plants.

Dr. Fitch was of the opinion that the cherry aphis lived only upon the garden cherry — not on any of our native or wild cherry trees, or upon any other tree. This opinion has not been sustained by our further acquaintance with the insect. Thus, in the year 1878, Dr. Thomas found it in Illinois, covering the twigs and axils of the small limbs of plum trees as well as the cherry, in confirmation of the statement of its occurrence on the plum that had been previously made by Mr. Walsh.

Mr. Buckton has observed viviparous specimens of it in limited number, on the black currant, showing the slight colorational difference of a duller body and paler cornicles.

It is possible that this species also extends its ravages to the peach tree, appearing there as a root-form infesting the roots. For many years past, the roots of peach trees along the Atlantic seaboard have been seriously infested with an aphis, to the extent of causing a great mortality, particularly in seedling trees. The attack was naturally referred to *Myzus persicæ*, but by some has been regarded as a distinct species. Examples of it sent to the Department of Agriculture at Washington, were pronounced by Professor Riley to be the *Myzus cerasi* of Fabricius, but in correspondence with him, the opinion is expressed that before its identity with that species can be positively asserted, additional study is necessary. For a notice of *M. ?cerasi*, on the roots of peach trees, the *Second Report on the Insects of New York*, pp. 19–22, may be referred to.

Remedies.

A kerosene and soap emulsion sprayed upon the insects would effectually kill all with which it came in contact. Clustered as they are on the under sides of the leaves, it would be necessary to apply the liquid from beneath the tree, changing position as might be necessary in order to reach every portion of the infested foliage. The statement of Dr. Fitch, that "these are creatures that *sprinkling* will not cleanse from the tree — *immersion* must be resorted to," may have been warranted by the sprinklers then in use, but is not sustained by the progress subsequently made in the discovery of insecticides and improved instruments for their application.

Strong soap-suds alone, although not entirely effectual, will materially reduce the aphids upon a tree — only the more hardy ones surviving its use.

Tobacco water, if made of sufficient strength, is claimed to be an effectual remedy for the insect. It has been used with unfailing suc-

cess when prepared "by boiling four or five pounds of tobacco in water sufficient to nearly fill a tin pan"— an indefinite measure, but a pan such as used upon a farm for milk may be presumed.

Dr. Fitch, at the time of his writing, regarded, as the very best measure for subduing these pests, that of using their natural enemies for the work. This was to be done by collecting from the hedges and borders of the forest in the neighborhood, by the aid of a beating-net, such as is sometimes used by entomologists for gathering insects, or an open inverted umbrella, or some other convenient implement, a few scores of their natural enemies (lady-bugs and their larvæ) and, conveying them alive in small boxes and vials, to set them free upon the infested tree. Their increase would be so wonderfully rapid that but a short time would be required to put an end to the aphis attack.

The convergent lady-bird, *Hippodamia convergens* Guer. [its orange-red wing-covers dotted with black spots and its black thorax marked with two converging pale lines, as shown in the slightly enlarged Fig. 31 at *c*, and in Fig. 32 more enlarged] could be conveniently used for this purpose early in the season, as it may be gathered by thousands during the month of May on the common Mayweed (*Maruta cotula*), and no better investment could be made by those who wish to destroy plant-lice than in the employment of boys to collect these lady-birds, four or five of which will clear a two-year-old peach tree in as many days (Riley, in *New York Tribune* for June 17, 1874).

a *b* *c*

FIG. 31. — The convergent lady-bug, HIPPODAMIA CONVERGENS; *a*, the larva; *b*, pupa; *c*, the imago or beetle.

Fig. 32.—HIPPODAMIA CONVERGENS, enlarged.

INSECT ATTACKS AND MISCELLANEOUS OBSERVATIONS.

A number of the following notices were contained in the Report of the State Entomologist to the Regents of the University, S. N. Y., for the year 1885, as published in the *Thirty-ninth Annual Report of the New York State Museum of Natural History.* No separates of the Entomologist's Report having been printed for general distribution, and the edition of the State Museum Report being quite small, portions of the former are herewith republished, that they may reach the agriculturists for whose benefit they were primarily prepared.

The Canker-worm.

Anisopteryx vernata (Peck).

It really seems that the canker-worm is becoming an annual pest of the orchards of the State of New York. While the New England orchards have been for many years ravaged by it, and the noble elms, so long the boast of eastern villages, destroyed, and it has also been

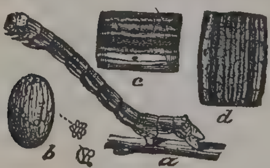

FIG. 33.—Larva and eggs of the spring canker-worm—ANISOPTERYX VERNATA. (After Riley.)

FIG. 34.—*a*, *b*, male and female moths of A. VERNATA; *c*, enlarged joints of female antenna; *d*, joint of female abdomen; *e*, ovipositor.

very destructive in several of the Western States, our own State, for some reason, has been almost exempt from its depredations. Within the last few years, occasional instances of its occurrence have been reported. Last year [1884] they were received from Poundridge and Pleasantville, in Westchester county, where they inflicted damage to the apple crop to the amount of thousands of dollars (*Country Gentleman* of July 10, 1884, p. 577). The present year, report is received of serious injuries from them in Wayne county. A gentleman writes:

"The orchards are all being destroyed in this part of the State by the canker-worm. Thrifty orchards were cut down last winter, and there will be many more sacrificed if there can not be found some way to stop the havoc."

Early in June their presence in the vicinity of Albany was reported, where I had not previously heard of their occurrence. Examples of the caterpillar were brought to me by Mr. David M. Knickerbocker, of Albany, that I might see if they were, as he believed, the veritable canker-worm. They were found upon his apple trees at Loudonville, in "millions," and were rapidly consuming the foliage. He had also heard of their presence in other orchards in his neighborhood. The examples of the larvæ brought were nearly full-grown (on June ninth), having almost attained their maximum length of one inch. As usual, they differed greatly in their markings and colors, some being almost without stripes and of a uniform black.

The folly and the criminality of permitting this destructive pest to obtain a permanent footing within our State can not be too strongly censured. It is an extremely local pest and, at the outset, can be easily controlled. Often one tree only in an orchard is infested, or a portion of an orchard, or a single orchard in a township, while others are wholly free from it. The female moth has no wings with which to distribute herself, and can only, upon coming out from her pupation in the ground underneath the tree in the early spring, climb up the trunk, meet her winged mate, and deposit her eggs upon the branches.

Preventives and Remedies.

The preventives and remedies that should be used against this insect are simple. First, the females should be prevented from ascending the tree, by cloth bands, coated with tar or printer's ink, around the trunk, or by some of the mechanical appliances which have been so frequently described in our agricultural journals and entomological reports. Second, when the larvæ are upon the tree and rapidly consuming the young leaves, they should be killed by spraying the tree with Paris green water, as in directions so often published. Third, if the caterpillars have been permitted to feed to maturity upon the trees, and thereafter to enter the ground immediately beneath for their transformation, the soil under the trees to the depth of from four to six inches should be thoroughly worked so as to crush the tender pupæ.

Either one of the above measures, if properly used, will be effectual in arresting the attack. If all are employed, immediate success would be insured.

Abundance of Geometrid Larvæ.

Mr. Verplanck Colvin, Superintendent of the New York State Land Survey, writes from his camp, on Salmon lake, head-waters of Beaver

river, under date of August 5, 1888, as follows, of some insects that came under his observation:

I believe you would be interested were you with us, for we are constantly meeting what are, to us, such novel forms of insect life that I feel confident you would find some undescribed species. What seems to me most novel, from an entomological standpoint, is the abundance of larvæ of the kind known as "measuring-worms." I never saw so many of these insects in the woods. They attack the witch-hobble [*Viburnum lantanoides*], which is usually quite free from insect injury, and reduce the leaves to skeletons. But they do not, by any means, confine their attack to deciduous vegetation, but are also found on evergreens—on balsam and spruce—and their number is infinite. The common form is a bright green worm of about one inch in length: another is a dark gray or brown. Both of these attack the human being with a sharp and painful bite — a surprising thing, as I have never known such larvæ to attack animals before. They are certainly worthy of your observation and study.

The Apple-leaf Bucculatrix.

Through Dr. Sturtevant, of the New York Agricultural Experiment Station, a communication was received from Mr. Malcolm Little, of Malcolm, Seneca county, N. Y., stating that the apple orchards in that vicinity were infested upon the branches and the fruit with objects such as sent upon some twigs. They had not been seen before, and it was asked what they were, and if they would probably prove injurious. Answer to the following effect was returned:

The twigs received were thickly covered on one side with the cocoons of the apple-leaf Bucculatrix — *Bucculatrix pomifoliella* Clemens. A piece of twig an inch and a quarter in length, and one-eighth of an inch in diameter, had upon it thirty-three of these cocoons. From the small size and the general appearance of the cocoons they are often mistaken for insect eggs. They are white, about one-fourth of an inch long, as thick as an ordinary pin, and show upon their exposed surface five or six prominent longitudinal ribs as represented at *a* in Fig. 35, and at *b* in enlargement.

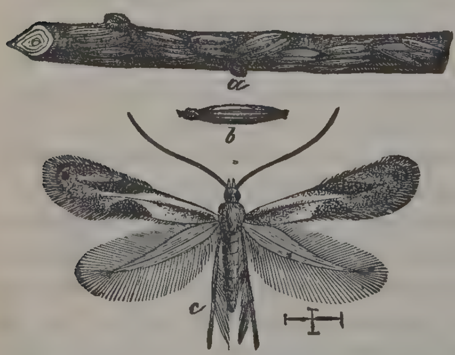

Fig. 35.— Apple-leaf Bucculatrix, Bucculatrix pomifoliella: *a*, piece of twig covered with cocoons; *b*, cocoon enlarged; *c*, the moth, enlarged.

The insect is an injurious one. Where it abounds, the caterpillars consume such an amount of the foliage as seriously to interfere with the production of the fruit. It displays a remarkable facility for

increase, and every proper means should, therefore, immediately upon its discovery, be resorted to, that its spread may be arrested.

The parent is a small moth (shown at *c*, much enlarged) belonging to the *Tineidæ* — that division of the Lepidoptera that embraces the smallest species of the order. There are two annual broods of the insect. The cocoons sent to me are of each brood. Some of them were spun in July, and have given out the insect, leaving only the empty pupa-case within the cocoon. The moths that emerged from them laid eggs from which the caterpillars were hatched, which might have been observed feeding upon the leaves in September, if attention had been given at the time to the eaten foliage. The caterpillars make their cocoons during October, and upon opening those that are the freshest-looking and unbroken, the pupæ may be found which are destined, if not meanwhile destroyed through parasitic or atmospheric agency, to remain in that state throughout the winter, and to give out the moth in the month of May next.

A notice of this insect, containing further information upon it, may be found in my "First Annual Report on the Insects of New York, 1882, pages 157–162."

Distribution.

In the above publication, the presence of this insect had only been reported within the State of New York, in Monroe and Chemung counties. As would naturally be expected, it seems to be extending its range. It has since been received by me, from an orchard of Mr. J. S. Roy, Lyons, Wayne county. A piece of twig only two and one-half inches long contained twenty-two of the cocoons. It has also been sent to me by Mr. J. C. Wolf, of Waterloo, Seneca county. It is reported as present, in small numbers as yet, in Lagrange, Wyoming county. It also occurs in South Byron, Genesee county.

I had previously written of this insect, that as yet in its New York distribution, it was apparently confined to the western portion of the State, but the present year it has been brought to me from an orchard at Bethlehem Centre, five miles south of Albany, on the Hudson river. Mr. Isaac Bussing, with whom it occurred, reports that he has observed it upon his trees for the past few years, in limited numbers, but does not think that it inflicted serious harm.

In the *Second Report of the Department of Entomology of the Cornell University Experiment Station*, 1883, Mr. A. E. Brunn has published his studies upon the life-history of this insect (with illustrations of some of its stages) which adds materially to our previous knowledge of it (*l. c.*, pp. 157–161, pl. 6, figs. 2–2*e*). An abstract of the above observa-

tions has been given by Professor J. H. Comstock, in the *Proceedings of the Western New York Horticultural Society*, at its twenty-eighth annual meeting in January, 1883 (pp. 20–23).

Remedies.

This injurious pest is the most vulnerable in either its caterpillar stage or after the cocoons have been made. In large orchards the cocoons may be best attacked by means of a mixture of kerosene and soap sprayed upon them with a force-pump. This emulsion which is quite as effectual as, and easier to make than, the milk emulsion formerly recommended, may be made by dissolving two pounds of common bar soap in a gallon of water, with heat, and then mixing in a gallon of kerosene with the aid of a force-pump until emulsified. This, upon cooling, will form a thick, gelatinous mass, containing fifty per cent of kerosene, which will have to be reduced by the addition of water before it can be applied with a force-pump. If diluted with nine gallons of water, giving a mixture of about ten per cent of kerosene, it should give a strength sufficient to destroy the pupæ within the cocoons, but the proper strength had better be first ascertained by experiment upon a few of the cocoons.

If the infested trees are not very numerous the emulsion might be applied to the branches by means of a stiff bristle-brush, which would remove the cocoons, and serve to show thereafter if there is a continance of the attack in the deposit of fresh cocoons.

When the caterpillars are found in abundance feeding on the trees in July or September, by suddenly jarring the branches, numbers will drop and hang suspended by their threads, when they may be swept down by brooms or branches and destroyed. Showering the trees with Paris green and water would kill all the larvæ eating the poisoned foliage.

The Clover-seed Midge.

Cecidomyia leguminiçola Lintn.

A package of the larvæ of the clover-seed midge was received October twelfth, through Dr. E. L. Sturtevant, from Mr. D. M. Linsley, of Orleans county, N. Y., with the statement that they were from a second crop of clover, that had been cut for hay, and placed on a scaffolding above the barn floor. Four or five days thereafter the larvæ were observed in large numbers upon the floor beneath the clover. Mr. Linsley was desirous of knowing if they would attack any other grain or plants. Answer was made that the attack of the clover-seed midge, so far as known, was confined to clover seed. From the abundance of the larvæ reported by him, it was quite important, as a

means towards diminishing the attack of the coming year, that the larvæ falling upon the floor should be frequently swept up (if the floor was a tight one) and burned. If in the sweeping the larvæ were liable to fall through the floor-joinings, it would be advisable to kill them before attempting their removal by sprinkling them from time to time with kerosene.

The following extracts are from a letter received later from Mr. Linsley in reply to the request made for additional information of the occurrence of the larvæ:

They came wholly from the second cutting of the clover, cut about the twentieth of September. They began to make their appearance about four days after it was drawn into the barn. They came out in such numbers that they looked like red sand upon the floor. This continued for about two weeks, since which time I have not noticed any of them. I destroyed what I could collect from the floor, but the greater part of the hay being put into a mow, they were, of course, out of reach for the most part. * * * * *

It is said that these weevils do not work in the Alsike, or large pea-vine clover. This may be due to the fact that in these varieties the first growth of cutting is used for seed, so that the seed matures too early for the insect. But these varieties are far inferior to the Medium clover and can not well supply the place of it. The destruction of the crop of Medium clover seed is a very serious loss to the agricultural interest in this portion of the State, amounting to from twenty to forty dollars per year on every farm of 100 acrès, according to the market price of the seed.

The Hessian-fly.

Cecidomyia destructor Say.

Wheat infested between the first and second joints with the Hessian-fly, was sent for examination, June twelfth, by Mr. A. F. Dowd, of North Huron, Wayne county, N. Y. On stripping the sheaths from the stalks, four or five of the puparia, or "flaxseeds" as they are popularly called, would be found in company, showing the attack to be a severe one. [See figure 45 on page 286.]

The perfect insects failed to develop. Under natural and favorable conditions they would probably have emerged in the month of July.

The fly had been more injurious in western New York the preceding year (1884) than usual. The following statement in relation to its operations, and containing some good suggestions for controlling the insect, is from a gentleman in Monroe county, which joins Wayne county on the west:

A considerable part of the wheat of 1884 was injured by the Hessian-fly, which crinkled the straw so that the heads of wheat were cut off too short to be gathered in harvest. On some fields this scatter-

ing wheat would make, if evenly distributed, a sufficient seeding. I am afraid this self-sown wheat will prove a detriment to the crop, as the Hessian-fly will lay her eggs on these early plants.

The fly works until frosts check it. Rolling the ground or dragging with the smoothing harrow, and then rolling, is probably as good a preventive of injury from the Hessian-fly as can now [late in September] be applied. These operations both cause the wheat to stack more, making a mass of small leaves rather than one or two tall ones from each plant. As the fly lays her eggs in the fold of the leaf [at the crown of the root], she finds less place than where the leaves are unchecked in growth. Besides, many of the eggs and newly-hatched worms are destroyed by crushing and contact with soil brushed against them.—W. J. F., Monroe county, N. Y. (*Country Gentleman* for October 9, 1884.)

Some plants of winter wheat in ground, containing the flaxseeds of the Hessian fly, were received from Prof. F. M. Webster, of La Fayette, Ind., on April fourteenth. On April nineteenth six of the flies emerged, males, and additional ones as follows: On the twentieth, four ♂; on twenty-first, seven ♂ and fourteen ♀; twenty-second, not observed; on twenty-third, about sixty ♂ and ♀ were taken from the box, some of which were dead.

Sciara sp. ? Occurring on Wheat.

Examples of a small fly were received October second, from Dr. E. L. Sturtevant, which "had appeared upon wheat" at the Experimer Station.

In our present limited knowledge of the species of this genus, a generic determination only could be made of it.

From what is known of the larval habits of the few *Sciara* that have been studied, and of their associated *Mycetophilidæ*, it is not probable that the species sent was injurious to wheat. The larvæ, as a class, are not regarded as injurious, as many of them are known to occur beneath the bark of felled trees, in decayed wood and vegetables, in vegetable mold, in fungi, etc.

From their frequent occurrence in boleti and fungi, Latreille had arranged the *Mycetophilidæ* in his group of *Fungivores* — one of the five into which he divided the *Tipulidæ*. A noted fungivorous species is the *Sciara Thomæ* Linn., of Europe, known as the "army-worm" (Hierwurm) in Germany. The larvæ are remarkable for assembling in immense numbers and hanging together by means of a viscid moisture in a long mass resembling a snake or rope, sometimes several feet in length, two or three inches in breadth, and perhaps a half inch in thickness. Larger processions of these larvæ have been observed,

massed in a breadth of three inches and one or two inches in thickness, and extending thirty yards in length. Individually, they are but about five lines long and a third of a line in diameter. M. Guérin-Méneville has given interesting details of some of these assemblies observed by him, some of which have been quoted in *Figuier's Insect World*, pp. 46, 47.

That some of the species of the genus may possess injurious habits appears from the mention by Prof. Westwood, that Olivier had reared three species of *Sciara* from wheat, of which account is given in *Prem. Mém. sur quelques Insectes qui attaquent les Céreales*, Paris, 1813.

Sciara pyri, of Europe, is said to injure the blossoms and fruit of the pear, causing them to fall; while of other European species, *S. fucata* lives in decaying potatoes, turnips and other vegetables; *S. quinquelineata* breeds in diseased potatoes and is supposed, by some, to cause the "scab;" *S. pulicaria, S. vittata, S. longipes*, and *S. hyalipennis*, have also been bred from decaying potatoes; *S. tilicola* produces a gall on the leaves of young linden trees; and *S. Giraudii* has been bred from stems of *Malva* and *Althœa.*

One of our American species, at least, is known to be injurious, viz., *Sciari mali* (Fitch), the larvæ of which destroy the interior of apples by burrowing through them, while the fair exterior shows no indication of the concealed attack. A species of *Sciara*, apparently near to *S. nervosa*, of Europe, has recently been brought to me (1889), as infesting mushroom beds in Albany, where it has been regarded as injurious to mushroom culture. Mr. Wm. Falconer has also sent me the same species from mushroom cellars in Glen Cove, Long Island, but does not consider it harmful. It will be given study, and reported upon hereafter.

The Osten Sacken catalogue of N. A. Diptera contains twenty-three species of *Sciara* described by Say, Walker, and others, but of these very few have been identified in present collections. For notice of the habits of some of the *Sciara*, see Osten Sacken, in *Proc. Ent. Soc. Phil.*, i, 1862, pp. 163–165; and for references to writings upon them, pp. 169–171.

The Cabbage-fly.

Anthomyia brassicæ Bouché.

A severe attack of this insect upon young cauliflower plants was reported by Mr. D. W. Seeley, of Albany, and examples of the plants badly eaten and having the larvæ within and upon their roots, were brought to me on June eighth. Mr. Seeley had made several appli-

cations of popular remedies for the arrest of the attack, without avail, and had nearly determined upon taking up the entire crop and destroying it, although it would be at a loss of about a thousand dollars — the estimated value of the matured crop. The application of bisulphide of carbon was recommended to him before an abandonment of the crop; the result of the application, if made, was not learned.

Some of the above larvæ, apparently full-grown, were placed in a box with ground when received. Sixteen days thereafter, June twenty-fourth, they gave forth the perfect fly.

A Lady-bug Attack on Scale-insects.

A number of Austrian pines, *Pinus Austriaca*, in Washington park, Albany, were observed, on October ninth, as having been very nearly killed by an attack of the pine-leaf scale-insect, *Chionaspis pinifolii*

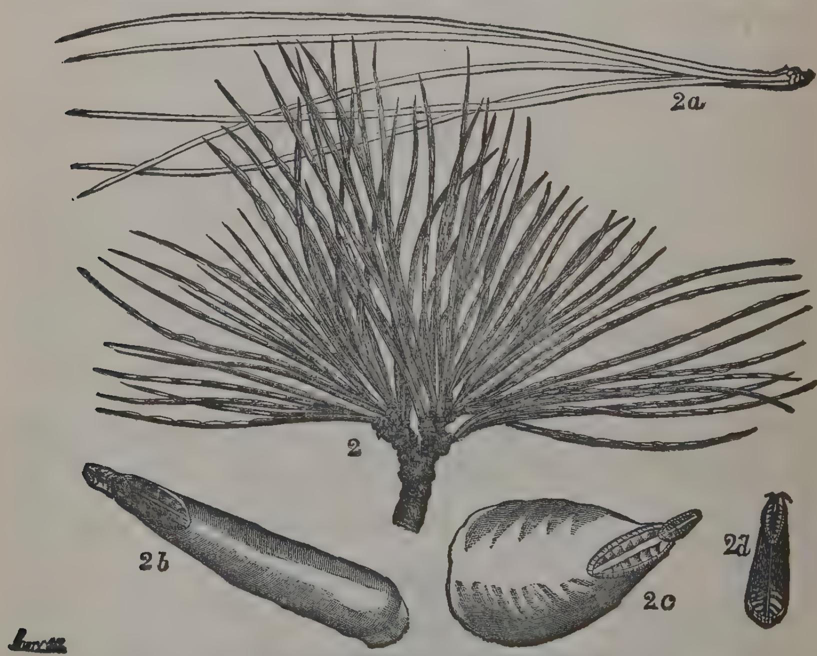

Fig. 36.— The pine-leaf scale-insect, Chionaspis pinifolii.

(Fitch). Millions of the peculiar white scales of this destructive species had attached themselves to the leaves almost as thickly as they could find place, to the extent of whitening the tree, and nearly hiding its

natural green. Hundreds of scales could be counted upon a single one of its slender leaves. The scales are represented in Fig. 36 in their natural size on the leaves of *Pinus strobus*, at 2. At 2*a*, are leaves of the same not stunted by the presence of the scales; 2*b*, a scale of female, of usual form, enlarged; 2*c*, wide form of the same, enlarged; 2*d*, a male scale enlarged. The figure is from Prof. J. H. Comstock's *Report to the U. S. Department of Agriculture* for the year 1880, while Entomologist of the Department.

The species of lady-bug, *Chilocorus bivulnerus* Muls., which seems to be specially commissioned to feed upon the eggs of this and other scale-insects, was present upon the trees in great abundance. Its larval stage had already passed, and it was now occurring in its pupal and perfect stages. The larval cases, split longitudinally upon their back, and disclosing the pupal case within, were quite numerous; as many as ten of these could be seen upon a single leaf. The larger number of pupæ had given out the pretty beetle, with its shining black wing-covers, bearing centrally upon each a blood-red spot — the two spots suggesting the common name that it bears of "the twice-stabbed lady-bird." A few of the beetles were still emerging, with pale ochraceous-colored elytra, and without the least indication of the two red spots which are gradually developed later with the darkening of the wing-covers. In a few minutes time, about one hundred and fifty of the beetles were collected from the leaves and branches of a pine — most of them from the branches, on which they were found quietly resting.

Fig. 37.— The Twice-stabbed lady bird, Chilocorus bivulnerus: The larva and imago.

An examination of the scales upon the more badly infested trees showed that most of them had been eaten into and their contents destroyed.

From pupæ collected and taken to my office, the beetles continued to emerge for about ten days thereafter.

The Carpet Beetle.

Anthrenus scrophulariæ (Linn.).

A very early date for the appearance of this beetle abroad is April twenty-seventh, at which time it was found feeding on the pollen of a Crocus, associated with *Anthrenus varius* Fabr., by Mrs. Hoagland, of Albany. It seemed to show a preference for the white-

flowered Crocus, in which sometimes a half-dozen of the carpet-beetles would be seen at the same time.

An early date for its flight within doors is March sixth, when an example of it was seen floating in the water of an aquarium in my office. It is probable, however, that the beetle may at any time during the winter months, be brought out from its quiet and often protracted repose within its ruptured pupal skin (alike contained within the split larval skin), as it has been observed under such conditions, disclosing segments of its brilliantly-scaled wing-covers, on November eighteenth. A number of our noted household pests, in their perfect domestication, are apparently no longer subject to stated times for the appearance of their successive broods.

Fig. 38.— The Carpet-beetle, Anthrenus scrophulariæ.

As a Museum Pest.—From a box of unspread *Noctuidæ*, contained in a drawer of the entomological cabinet at the Capitol, two examples of *A. scrophulariæ* and three of *A. varius*, were taken on January 11, 1888 ; the note made at the time does not state how many of them were alive. The only other instance under my observation of the carpet-beetle as an insect pest, was in finding a living imago, early in January, in association with an *Eumenes fraterna*, upon which it had evidently been feeding and partially consumed.

The Oak-pruner.

Elaphidion parallelum (Newm.).

Mr. George Theo. Lyman, of Bellport, Suffolk Co., N. Y., writes of an extraordinary increase this year (1887) of this oak-pruner. He had gathered, on his place alone, six large cart-loads of the severed twigs.

Most of the twigs, on examination, were found to contain the larva, but in quite a number it was absent, and in these cases there was a hole in the cut-off end. He was led, from this observation, to question the statement of Harris and others, that the insect transformed within the twig. Reply was made that in these cases, probably, the packing of the burrow in the excised section had been eaten into by some bird or predatory insect, and the larva devoured. That many of the larvæ and pupæ are thus destroyed has been recorded by different writers. Dr. Fitch records that insectivorous birds have frequently been seen industriously picking around the ends of the

twigs lying on the ground, and that doubtless the oak-pruner often falls a prey to these sagacious and diligent foragers.

Mr. Lyman had also observed this present season, at Waltham, Mass., where there are many oaks, the same ravages of this insect as at his home at Bellport, L. I. He had cut open the burrows of many, at Waltham, and had found the grub in most, but it seemed to differ from those at Bellport, in being larger, longer, having a less pointed tail, and a square, blunt head.

He also noticed that some of the twigs, unmistakably cut off by the grub, had no burrow in them, but only a shallow pit of the diameter of a burrow on the severed surface, raising the question, in his mind, whether the grub did not sometimes lose its direction and burrow downward toward the trunk instead of from it.

Oviposition of Saperda candida Fabr.

The following notes, condensed from a communication made by E. W. Junkins, of Carroll Co., N. H., to the *New England Homestead*, of January 3, 1885, are of value as an addition to our knowledge of the habits and life-history of the destructive round-headed apple-tree borer, *Saperda candida:*

A part of a trunk of an apple tree that had been killed by the borers and taken within doors in the early spring, showed, through a crack opened by drying, a pupa of the beetle, on May twentieth. On June eighth it had changed to the beetle (indicating a pupal period of at least nineteen days). Four other specimens that afterward emerged were inclosed in a large glass jar containing wet sand at the bottom, into which were thrust some shoots of an apple tree. The beetles fed upon the tender bark. On June fifteenth, one of the four females was seen depositing an egg. "She first made an incision in the bark close to the sand; then turning head upward, with her ovipositor she placed the egg under the bark nearly a quarter of an inch from the incision, the bark having been started from the wood. July seventh a young borer, three-sixteenths of an inch long, made its appearance. July eleventh, the sticks near the sand were full of eggs, and the beetles were depositing their eggs higher up on the sticks. July eighteenth, one of the borers, three-eighths of an inch long, had worked an inch and a half downward. August seventh, the last beetle died, but would doubtless have lived longer with better care."

On the twenty-sixth of August a beetle was captured among the branches of an apple tree, in the trunk of which eight young borers

were found. The beetle was kept alive for several days and deposited an egg.

This insect is probably known generally to the orchardists in localities where it occurs in injurious numbers, but for the benefit of those

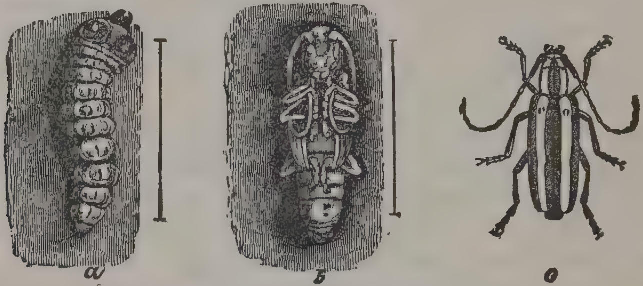

Fig. 39.—The round-headed apple-tree borer, SAPERDA CANDIDA; *a*, the grub or larva; *b*, the pupa; *c*, the imago or beetle.

who may not be familiar with its appearance, representation is given of it in Fig. 39 above.

The above observations of Mr. Junkins are of considerable importance, as they extend the period of oviposition of the beetle much beyond the period heretofore assigned to it, and consequently the time during which the application of soap to the trunk of the apple tree to protect it from the egg-deposit is to be made, will also require a corresponding extension.

Professor Riley has stated:

The female deposits her eggs during the month of June, and the young worms hatch and commence boring into the bark within a fortnight afterward. * * * Keep the base of every tree in the orchard free from weeds and trash, and apply soap to them during the month of May, and they will not likely be troubled with borers. (*First Report on the Insects of Missouri*, pp. 43, 45.)

Dr. Fitch states as follows in his account of this insect given in his *First Report on the Insects of New York:*

The beetle makes its appearance every year early in June. * * * In the course of this and the following month the female deposits her eggs (page 13).

Commonly, here in Washington county, they begin to be found upon trees about the twentieth of June, from which time until the close of the month they appear to be more numerous than they are afterward (page 17).

In all orchards where the borer is present, this measure [soap application] should invariably be resorted to the latter part of May, or in more northern localities, where the beetle will be somewhat later in appearance, early in June (page 22).

Referring to Mr. Junkins' observations of the first egg having been deposited after the middle of June, many after July eleventh, and oviposition continued even after the twenty-sixth of August (probably into September), it would seem advisable that the use of the soap application — perhaps our best preventive of the injuries of this pernicious borer — should, in northern New York, not be delayed longer than the first week of June, and should be continued *through the month of July* and into August.

Mr. Charles G. Atkins, of Bucksport, Maine, in a paper read before the Maine State Pomological Society at its last annual meeting, confirms the above observations on the late oviposition of *Saperda candida.* He has found the egg-laying to begin (at his farm in Kennebec county) soon after the middle of June, and to continue until late in August, and had met with unhatched eggs after the first of September.

Mr. Atkins offers the suggestion that relief from this apple-tree borer may be better sought through remedial than preventive measures. With young trees having a smooth bark he would prefer mounding the base to a height of six inches or more with sand, thus compelling the borer to place its eggs where they, or the young larvæ emerging from them and entering the bark, may easily be discovered by proper inspection and destroyed. (*Home Farm*, March 5, 1885.)

Orthaltica copalina (Fabr.).

Numbers of this beetle were observed at Schoharie, N. Y., on July sixth, feeding on the leaves of *Rhus typhina.* It was the first time that the species had been noticed by me upon this plant. Many of the beetles were paired, while others were engaged in feeding on the lower surface of the leaves which they eat away, causing them to dry up and shrivel as if from the effect of heat.

This species belongs to the *Chrysomelidœ*, and to the group *Crepidoderœ.* In systematic arrangement it comes next to *Epitrix*, and is, therefore, closely allied to the well-known cucumber flea-beetle, *Epitrix cucumeris* (Harris), which at the present time is so injurious to the potato crop in the State of New York.

In the sixth Missouri report, Professor Riley has given illustration, the life-history, etc., of another sumach-feeding Chrysomelid, *Blapharida rhois* (Forst.), which he designates as the "jumping sumach beetle." It feeds readily on all of our indigenous sumachs, and in some years completely denudes them over large tracts of territory.

The Clover-leaf Weevil Destroyed by a Fungus Attack.

Phytonomus punctatus (Fabr.) — *Entomophthora Phytonomi* Arthur.

During the latter part of May, 1885, some larvæ were received from Dr. E. L. Sturtevant, which had been taken from the grounds of the New York Agricultural Experiment Station, at Geneva, and had evidently been killed by a fungus attack. The larvæ were found attached to, and coiled around, the tips of blades of grass, dead, stiffened, shrunken, and partly covered with a whitish fungus. From a careful examination of the larvæ, it seemed probable that they were immature forms of the punctured clover-leaf weevil, *Phytonomus punctatus.* The beetle is shown in Fig. 40, in twice its natural size.

Other examples of the larvæ were received from the same source, on November third, in the same condition with those previously sent. Not being positive of my determination of the species, request was made for living examples, to be sought for buried beneath the surface of the ground, or while feeding at night, but they could not be obtained. Some of the material was, therefore, sent to the Entomological Division of the Department of Agriculture at Washington, where it was compared with alcoholic specimens, and was found, from the structure and markings of the head of the larva, to be, beyond doubt, that of *Phytonomus punctatus.*

Fig. 40.—The punctured clover-leaf weevil, Phytonomus punctatus; dorsal and side views.

Dr. Sturtevant having suggested the possibility that the fungus attack may have been the result of the fertilizer used at the station, the fungus was shown to Prof. Peck, the New York State Botanist. It was pronounced by him, in all probability, an undescribed species, allied to the well-known fly-fungus, *Empusa muscæ.*

On mentioning the above facts to Hon. G. W. Clinton, he expressed his belief that the fungus may have been communicated in the manner suggested by Dr. Sturtevant, if fish-remains entered into the composition of the fertilizer, from the fact that a common fungus found infesting fishes is the *Saprolignea ferax*, which is believed to be but the aquatic form of the *Empusa muscæ.*

The above was communicated to Dr. Sturtevant, with an inquiry of the nature of the fertilizer that had been used. Answer was returned that he had obtained from the manufacturers the formula of its composition, and that "the nitrogenous material was supplied by *acidulated fish-skins*, dried ground horse-meat and western blood."

If, as seems not improbable, the death through fungoid attack of the larvæ, may be shown to be the result of the use of the fertilizer, either through the discovery of the same fungus in the fertilizer, or,

better still, by experiments with healthy larvæ — the mortality of the larvæ observed at Geneva, by Dr. Sturtevant, will certainly be an event of unusual interest. It would appear to give us the means of destroying a pest which, up to the present, it has not been possible to control, while, at the same time, stimulating the infested crop and thereby enabling it the better to resist all other forms of insect attack. Nor would its efficacy be limited to this particular species, but it would be doubtless available against many other insect enemies, especially those that burrow in the ground, after the manner of the *Phytonomus.*

The fungus attack was subsequently studied by Professor J. C. Arthur, Botanist of the Experiment Station, and his report upon the same may be found in the Fourth Annual Report of the Station, 1886, pp. 258–262. It is there fully described by him, and also illustrated in four figures, under the name of *Entomophthora Phytonomi.* The following extract is made of the conduct of the infested larvæ and their appearance under the attack:

The sick larvæ of all ages crawl up the herbage during the night, and instead of again concealing themselves near the ground on the approach of light, as the healthy ones do, ascend as high as possible, and, if on grass, coil themselves in a horizontal position about the apex of the blade, as in Fig. 41, or if on other objects, take a position as nearly similar as the shape of the object permits. If disturbed before the middle of the forenoon, the majority are still able to crawl, although sluggishly: by noon most of them are quite dead, but unchanged in appearance. It will be found that they cling to the leaf with greater tenacity than during life. Examining the under sides of the body will disclose the fact that delicate, colorless holdfast have grown out from the median line, which, attaching themselves to the leaf, hold the insect firmly in place. Late in afternoon the body has changed from the normal yellowish or pea-green and smooth appearance to velvety-gray. The next morning there is only a small blackened and shriveled mass remaining, while the surrounding foliage is powdered with a whitish, clinging dust, composed of the spores of the fungus. * * * This is the general course of the rapid and fatal disease.

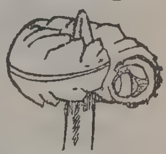

FIG. 41.—Fungus-attacked larva of PHYTONOMUS PUNCTATUS coiled about the tip of a blade of grass. Enlarged five diameters.

In 1886 and 1887 the insect did not appear on the grounds of the station in sufficient number to invite attention, and no further observations were made on the fungus attack.

POECILOCAPSUS LINEATUS (Fabr.).

From Mr. E. S. Goff, of the N. Y. Experiment Station, some Hemiptera, in their larval and pupal stages, feeding in the garden of the station upon sage, *Salvia officinalis,* were received June 1, 1885.

The larvæ were broadly elliptical. Head testaceous; eyes black; first joint of the antennæ testaceous, second joint pale basally, and the others pale at the joints. Thorax testaceous anteriorly, with two black spots on its hind margin, separated by a pale mesial line. Abdomen red, with eight transverse dorsal lines, broken mesially by a pale line; the rudimentary wing-pads black. Legs pale; femora darker above; tibiæ brown-spotted.

Pupæ.— Wing-pads more than one-half as long as the abdomen, shining black, with a broad whitish longitudinal line from their base, but not reaching the tip near their outer margin; this line continued in yellow upon the thorax, dividing each lateral black spot into two — the outer one being simply a marginal line. A yellowish dorsal line from the thorax over the abdomen; segments black except on their posterior margin and at their sides; femora with two black rings.

The imago from the above appeared on June thirteenth, in three examples, and proved to be the species named above, and commonly known as the "Four-lined leaf-bug." They were the variety *b*, described by Dr. Fitch as wanting the black dot at the end of the outer black stripe on the wing-covers, on the triangular piece marked off by a suture before the membranous tip. As the three examples were females, it was thought that the absence of the black spot might be a sexual feature, or possibly certain broods might be thus characterized. In accordance with a request made to Mr. Goff, a number of examples from the garden at the Experiment Station were sent to me. It was found from them that the spot gave no special indication, as of the thirteen males received seven were without the spot, and of the seven females, two.

Fig. 42.—The four-lined leaf-bug Pœcilocapsus lineatus, three times the natural size.

Mr. Goff stated that for the past three years this insect had appeared in very nearly the same place in the garden, but in somewhat greater numbers the present season. Last year (in 1884) it made a serious attack upon gooseberry bushes at the Experiment Station, depleting the tips of the young growth, so that they shriveled, wilted down and died. It was also received from Batavia, N. Y., as injuring sage in a garden.

While so abundant and destructive in my own garden in 1881 (see *First Rept. Insects N. Y.*, p. 271), it has not been injurious since, although examples of it have been observed each year, feeding on the black currant, *Ribes nigrum*.

Attack on Young Pears by a Plant-bug.

Messrs. Ellwanger & Barry, of the Mount Hope Nurseries at Rochester, N. Y., have sent me under date of June 19, 1884, some specimens of young pears, blotched and injured, together with insects taken upon them.

Some of the pears, of about one-half inch in diameter, show as many as forty blotches from an eighth of an inch in diameter downward. From the minute puncture originally made, the juice as it has escaped has become hardened and granulated, and with its increase has split the skin in different directions, often in a triangular form or one wound running into another. The more seriously injured pears would be rendered unfit for sale from their knotted surface, even if after such a drain upon them they should continue upon the tree, which is not at all probable.

The insects taken upon the injured fruit were the tarnished plant-bug, *Lygus pratensis* (Linn.). Although they were not actually observed feeding upon the juices, there can be no reasonable doubt of their being the authors of the injury. This form of attack (upon the fruit) has not been previously recorded, yet their fondness for the blossoms of the pear is known, and they are also known to be destructive to the fruit of the strawberry.

Fig. 43.—The Tarnished plant-bug, Lygus pratensis.

In the attack above recorded, the insect has apparently shown a preference in the variety of pear it has selected. Messrs. Ellwanger & Barry write: "The whole of the fruit in one of our orchards on the Duchesse d'Angouleme trees is affected; while on the Beurre d'Anjou and other varieties, we find nothing of the kind."

In the *American Entomologist*, ii, 1870, and in the *First Report on the Insects of New York*, 1882, statement is made of a pear orchard having been saved from the destruction of its blossom buds by this insect, by shaking them from the branches into a vessel of soap-suds, for three successive mornings. If equally effective in other instances of attack, it will prove a valuable remedy, for its control is often quite difficult, if not impossible.

This destructive plant-bug, of wide distribution over the United States, and of very injurious habits from its broad range of food-plants, has long been known as *Lygus lineolaris* Pal. Beauv., and has been but recently referred to the species described as *pratensis* by Linnæus.

An Experiment with the Thirteen-year Cicada.

The following paper was read before the Albany Institute at its meeting on October 6, 1885, with a view of making record of the planting of a brood of the "thirteen-year locust," at Kenwood, near Albany, and of the request that observations be made of the appearance of the winged insect at the time that its development may be expected:

"It is probably known to all the members of the Institute that notwithstanding the rapidity of multiplication in the insect world — very few of the species requiring more than a year for their life-cycle, and many having several generations in the year — one species requires seventeen years for its development from the egg to the perfect insect, viz., the seventeen-year Cicada, or the *Cicada septendecim.* That so exceptional a life-period is still doubted by many is not strange, in view of the fact that the Cicadas are seen to appear at shorter intervals than seventeen years — indeed, almost every year witnesses their appearance in some part of the United States. But this admits of easy and satisfactory explanation. There are a number of distinct broods occurring within the United States — no less than twenty-one are known — having each its geographical limits, sometimes overlapping one another, but each ever true to its seventeen-year period. Within the State of New York we have five of these broods, one of which made its appearance on Long Island during the past summer, in immense numbers, and another will appear also on Long Island in 1889.

"Besides this seventeen-year Cicada, Prof. Riley has also discovered the existence of a thirteen-year Cicada.

"No specific differences in appearance between these two forms can be detected, for which reason the latter is not accepted as a distinct species, but is regarded only as a form or race. The thirteen-year Cicada is a southern form, which, in its northern extension, does not reach further than into the southern part of Illinois. We do not have it in the State of New York.

"In the possibility that this short-period southern form may, in the lapse of time, have been developed from the normal seventeen-year race, as a consequence of the higher temperature of the Southern States hastening its development, Prof. Riley has, the present year, undertaken to test the effect of climate on the permanency of the two races, by transferring them from one region to the other. He thinks it possible that a southern brood brought northward might fail to appear at the expiration of thirteen years, and a northern brood taken south, might appear in a less time than seventeen years.

"Offering to him my assistance in the interesting experiment, he has sent to me a quantity of apple twigs from Mississippi, filled with the eggs of the thirteen-year Cicada, with the request that I would place them in an orchard where the result of the experiment could be observed at the proper time, and that I would also have proper record made of the same.

"I, therefore, ask place in some publication of the institute, for the statement that the orchard of Mr. Erastus Corning, at Kenwood, was selected for the planting of the eggs, from the considerations that it was a young orchard, that it promised permanency for the desired time, and that no other brood of Cicada would occur there with which this could be confounded. The tree beneath which the eggs were placed (they were hatching at the time, and the twigs containing them set about the base of the tree, and tied to its lower branches) was marked with a zinc label, bearing this inscription:

"'*Thirteen-year brood of Cicada* (*Riley's Brood, No. VII*) — *eggs from Oxford, Mississippi, planted July* 4, 1885.'

"Additional eggs from a second sending were placed beneath the same tree on July twenty-first, and also some in a wood adjoining, a few rods toward the south, to serve as a food-supply in the event of the death or destruction of the orchard.

"As I may hardly hope to see the result of this experiment, may I beg of some of the members of the Institute who are interested in Natural History, that *in the month of June*, 1898, they will make examination of the labeled tree and trees adjoining, for the pupa cases of the Cicada that should be found upon the trunks, if still obedient to their thirteen-year period, and for the insects in the vicinity, which should easily be discovered, if present, by their well-known song, which would readily reach the ear. Should they fail to appear at the time designated, then the search for them should be renewed the following year, and, if need be, for successive two or three years, until their appearance.

"The result of the observations should be communicated to the Entomological Division of the Department of Agriculture at Washington, unless it should be known that full examination had already been made by an agent delegated for the purpose from the department.

"In the planting of the eggs I was assisted by Mr. William Grey, gardener of Mr. Erastus Corning, who has been requested to communicate to others upon the farm the location of the tree in order that there may be no difficulty in finding the locality at the desired time.

"In addition to the above, other transfers of the eggs of the thirteen-year Cicada from Mississippi, have been made, to Ithaca, N. Y.;

Boston, Mass.; Kittery Point, Me.; Brunswick, Me.; and Ames, Iowa, as noticed in *Entomologica Americana*, for August, 1885, vol. 1, p. 96. Similar transfers, under direction of Professor Riley, of eggs of the seventeen-year Cicada, have been made the present year from Indiana, Michigan and Pennsylvania, to localities in Alabama, Georgia, Mississippi and Missouri."

[For a subsequent notice of the above series of experiments, see Professor Riley's report to the Department of Agriculture, for the year 1885, pp. 254–257.]

White Scale-insect Attack on Ivy.

Aspidiotus nerii Bouché.

The following note of inquiry in relation to a quite common insect attack of the ivy has been received from a lady in Watervliet, N. Y.:

"Inclosed please find a leaf of ivy. Will you kindly inform me of the cause of its peculiar appearance, and also the remedy, if any? The leaf and stem are alike infested, and the whole is in an unhealthy condition."

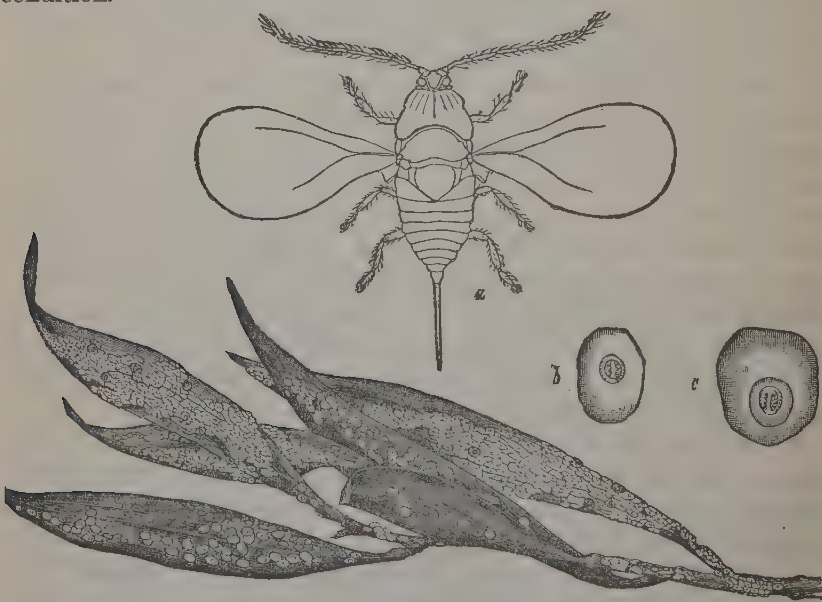

Fig. 44.—The White Scale, Aspidiotus nerii, in natural size, on an acacia twig: *a*, the winged male insect; *b*, the male scale; *c*, the female scale — each enlarged.

Reply was made that the leaf sent for examination showed upon both surfaces, clustering about the veins and more thinly distributed elsewhere, and upon the leaf-stalk, many whitish, rounded, slightly

convex spots, varying in size from almost microscopic to nearly as large as the head of a common pin. Examined under a lens, their peculiar elevated centers show them to be a species of scale-insect, known as *Aspidiotus nerii* Bouché [represented in the accompanying figure]. It is quite a common species upon the oleander, from which its specific name has been taken. Prof. Comstock in his notice of it — *Second Report in the Department of Entomology of the Cornell University Experiment Station*, 1883, states that it is generally distributed throughout the United States, and occurs upon the cherry, plum, currant, English ivy, maple, upon lemons from the Mediterranean, etc. These scale-insects are very injurious to the ivy when they attack it, for multiplying rapidly, their immense number make such a draft upon the juices of the plant that it can not long withstand the drain. On the first notice of the scales, their spread should be checked, if possible. If the plant is small, each leaf should be separately treated, by scraping the scales from them, or washing them with a strong soap solution, or a kerosene emulsion.

To larger plants the application would have to be made by sprinkling or by spraying with a force-pump.

By far the best time to attack the insect is when the young are first hatched and have crept out from beneath the sheltering scales. From their minuteness this could only be ascertained by the aid of a magnifying glass, under which they would appear as small dots slowly moving over the surface of the leaf. At this stage they could be killed by a solution of one pound of soap (strong rosin soap) in two gallons of water.

If not convenient to wait and watch for this phase of the insects' life, they may be killed at any time while in the egg stage beneath the scales by a kerosene and soap emulsion prepared as follows:

Dissolve one pound of rosin soap, in one quart of boiling water; add gradually one quart of kerosene, with constant stirring, until emulsified. The result will be a gelatinous compound consisting of fifty per cent of kerosene. This emulsion diluted, when used, with two gallons of water, would give a solution containing ten per cent of kerosene, which, if properly distributed so as to reach all of the scales, should be of sufficient strength to destroy the eggs without injury to the plant. [This formula is nearly the same as that given on page 262.]

The season at which the young insects hatch upon in-door plants depends upon the temperature of the room, but would ordinarily be during the latter part of winter.

The Black-knot of the Plum-tree and its Guests.

A piece of a limb of a plum-tree having the well-known "black knot" upon it was received in July, with the inquiry of the kind of insect that caused its growth, and if there was any remedy for the attack. The tree from which the piece was taken was wholly free from it, it was stated, in the spring.

It is a popular belief that the black-knot, so common on plum and cherry trees, and which causes annually the death of thousands of these trees throughout the United States, is produced by an insect attack. There is some foundation for this belief in the fact that insect larvæ are frequently found within the knot. These, however, are not the cause of the obnoxious growth, but merely enter it for food or shelter during its early formation.

The common plum curculio, *Conotrachelus nenuphar*, which is so destructive to the fruit of the plum-tree, has been bred by Dr. Fitch, Mr. Walsh, and others, from larvæ inhabiting the black-knot. Mr. Walsh has also bred from it five other species of insects — two of flies, viz.: *Ceratopogon* sp. and *Diplosis septemmaculata* Walsh, and three species of small moths, referred with doubt to the genus *Hedya* (*Practical Entomologist*, i, p. 50). Larvæ have on different occasions been taken by me from their cocoons made upon the margin of the black-knot, where it was overgrowing an excision of the preceding year, and the empty pupa-cases of evidently the same moth have been seen protruding from the knot. The moth, unfortunately, was not obtained, but it was probably that of *Ægeria pictipes* Grote-Rob., which is known to infest plum-trees sometimes in great numbers (*North American Entomologist*, i, 1879, pp. 17–21, with plate).

Although it is not many years since the origin of the black-knot was in doubt, for even in 1859, Dr. Fitch pronounced it not a fungus (*Trans. N. Y. State Agricultural Society for* 1859, xix, p. 606), it is now known to be a fungus growth of a species long ago described and named as *Sphæria morbosa* Schw. Quite recently it has been transferred to the genus *Plowrightia*, and this later generic name will probably ere long be generally accepted.

The specimen sent is of a brown color, for it is not until late in July or about the first of August that it presents its well-known black appearance, caused by "numerous coal-black hemispherical plates of about the size of the head of a pin, each of which is a distinct fungus."

Professor Riley has quoted Mr. Walsh as having shown that the black-knot fungus infesting the cultivated cherry "was quite distinct from that attacking the cultivated plums." He has also indicated another species occurring upon the "Miner plum," which may be seen "at a single glance to be essentially distinct from the common black-knot

of the plum." He writes: "It would seem to follow that there are three distinct black-knots, originating, respectively, from choke-cherry, from the common wild plum and from the Chickasaw plum." (*American Entomologist*, ii, 1870, p. 231.)

Those who have studied this fungus the most thoroughly believe in the existence of but one species, which readily transfers itself from the plum to the cherry, and the reverse. According to Professor Peck, New York State Botanist, "it is now known to occur on *Prunus domestica, P. Americana, P. cerasus, P. Virginiana, P. Pennsylvanica,* and *P. serotina.* Two of these are plum trees — one introduced, the other native — and the remaining four are cherry trees, of which the last three are indigenous" (*Thirty-first Report of the N. Y. State Museum of Natural History*, 1879, p. 60*).

Remedy.

The only remedy, so far as known, for the black-knot, is the free use of the knife as early as possible after its discovery. Mr. Walsh has emphasized the following as the remedy that may be relied on: "If the diseased twigs are cut off and destroyed early in July in the latitude of New York, or a little earlier or later according to the latitude, taking care to cut a few inches below the affected part, the black-knot can be checked and probably entirely eradicated; but if this operation is delayed until August, it will be of no benefit whatever."

If the above remedy is resorted to in the early stage of growth the limb or twig need not be removed, but the fungus can be cut out with a sharp knife while still confined to one side of the branch, permitting, if properly done, the wound to heal in a short time.

Those who experience difficulty in arresting the spread of the black-knot should avail themselves of the information contained in a paper entitled "Black-knot — Cause and Remedy," by Professor C. H. Peck, published in the *Country Gentleman* for June 28, 1888 (vol. liii, page 485). No paper of higher practical value has ever been published on the subject.

COLLECTIONS IN THE ADIRONDACK REGION, ET AL.

[From the Report of the Entomologist to the Regents of the University for 1883, published in the Thirty-seventh Annual Report of the New York State Museum of Natural History.]

The collections [for the year 1883] have mainly been made in Middleburgh, Schoharie county; at Elk lake, in Essex county; in the town of Hammond, St. Lawrence county; and in Albany.

*In addition to the species herein named, I have also observed it abundantly on the sand plum, *Prunus maratima*, on Coney Island.

Among those at Middleburgh were a number of *Trypetidæ*, of the group in which the wings are exquisitely marked with clouds and spots in the beautiful patterns so admirably delineated in the four plates of Baron Osten Sacken, and the late Dr. Loew, of Prussia, in their valuable Monographs of this interesting family. These flies had seldom fallen under my observation before, and then in only single examples; but at this time (middle of July) and place they were not at all uncommon, traveling, with the strange movements peculiar to them, over the leaves and stalks of the milkweed (*Asclepias cornuti*) and wild parsnip (*Pastinaca sativa*), within which the species may perhaps breed.

The time of my visit to Elk lake — August fifteenth to thirtieth — was favorable for the collection of two species of butterflies which are rarely met with in this State, except in localities having high elevations, approximating that of Elk lake, which is 2,000 feet above tide. *Grapta Faunus* (Edw.) and *Grapta j-album* (Boisd.-Lec.) were comparatively abundant in the roadway leading to the lake, resting for a while upon the damp soil to imbibe its moisture and then flitting away to the adjoining shrubbery. Both species had evidently but just emerged from their pupal stage. Of another species of butterfly, *Feniseca Tarquinius* (Fabr.), which appears to be quite local in its distribution and to occur more frequently within this State, in the Adirondack region than elsewhere, several examples were captured, but all in indifferent condition, showing that they had already been abroad for a number of days. Its larval food-plant was said by Mr. Glover to be hawthorn (*Cratægus*),* but in this and in both previous instances in which the butterfly has been observed by me, it has been associated with alders (*Alnus* species), and where the hawthorn was not seen to occur.

An interesting illustration of the abundance at times and in certain localities of a particular species of insect, conjoined with the absence of other allied and perhaps more common forms, was given me at this locality. With a single exception, in a solitary example of *Catocala unijuga* Walker, the only noctuid moth observed during my fortnight's sojourn here was *Agrotis clandestina* (Harris). To add to the interest, all the examples had one common hiding-place, viz., behind and about the sliding window-sashes of the exceedingly simple log structure that was dignified with the name of the Elk Lake Hotel. The only conceivable attraction of such a multitude of moths to their covert was a single kerosene hand-lamp, and later at night for a brief

* The larva has since been found to feed on the woolly plant-lice that occur in large clusters on the trunks and limbs of Alders: See *4th Rept. Ins. N. Y.*, 1888, *p.* 179.

space of time, a candle in each of the four bed-rooms. Their assemblage in such numbers, under such circumstances, was a mystery to me. A sash could not be moved without disturbing a dozen of them. Hundreds could have been captured, but as many were in poor condition and the species is a common one, twenty-five examples only were brought away.

The black-fly, *Simulium molestum*, was abundant, but not very troublesome, for in the month of August it ceases to show the insatiable disposition to gorge itself with blood that it manifests in the preceding months.* A number of specimens were captured and bottled for the Museum collections as objects of interest to the many who have never recognized this minute yet most annoying pest of our Northern Wilderness.

Upon some cut poplars (*Populus tremuloides*) piled by the way-side, a large number of a wood-boring beetle, *Agrilus torpidus* Lec., which I had never met with before, were observed alighting from their flight in the bright sunshine, and running actively, in jerking motions, over the bark. Sixty-two examples of it were taken. Its larva is probably a borer in the poplar.

Collections in the Adirondack Region in 1885.

[From the Report of the Entomologist to the Regents of the University for 1885. Published in the Thirth-ninth Annual Report of the New York State Museum of Natural History.]

About three weeks in the month of August were devoted to collections in the Adirondack region, at Long lake, in the northern part of Hamilton county, N. Y. The altitude of the lake is 1,632 feet above tide. This elevation is too great to admit of an abundance of insect life, while it fails to reward the collector with the rare forms which are to be met with at higher elevations — at and above 2,500 feet.

Very little is known, as yet, of the insect fauna of this interesting portion of our State. As I have previously written, "The enthusiasm of the entomologists of an adjoining State has led them to explorations of a peculiarly interesting field lying beyond the limits of their own State — the White Mountains of New Hampshire. For successive years the members of the Cambridge Entomological Club have established a midsummer encampment upon the slope of

* The guides of this region have a familiar saying, that "the black-fly doesn't bite after it has put on its white stockings," referring to the white bands upon its legs. Probably this is a different species and more blood-thirsty than the form that abounds earlier in the season and not thus marked. Unfortunately, the black-flies of the Adirondacks have not been studied, and *Simulium molestum* is only a manuscript name.

Mt. Washington, during which, through their protracted sojourn of weeks, and opportunity for collecting crepuscular and nocturnal forms, they have been able to enrich their cabinets, and those of their correspondents, with many rare boreal species, to accumulate much valuable biological information, and to present local lists of Lepidoptera, Coleoptera, and Orthoptera, which have been received as special contributions to science.

"Meanwhile the extensive Adirondack region, with its numerous lofty mountain peaks, its deep gorges, its hundreds of lakes — perhaps second only to the White mountains in point of interest to the entomologist of any locality in the United States east of the Rocky mountains — has been permitted, year after year, to bury within itself its entire entomological wealth. Previous to the collections noticed in this paper [*Lepidoptera of the Adirondack Region* *], hardly an insect had been drawn from it. At the present nothing has been reported of its mountain insect fauna. Many new species are undoubtedly to be discovered there, and the first comparison of its fauna with that of other elevated and more northern regions is yet to be made.

"It is sincerely to be hoped that, from the growing interest manifested in entomology, the numerous accessions to the number of its students, the facility for study afforded by recent publications and in several extensive classified collections, the reproach resting on the entomologists of New York may speedily be removed. And while the thorough exploration of any locality can scarcely fail of bringing to light much new material, the ambitious student may have for his incentive the assurance that in the Adirondack mountains there is open to him an unexplored field where faithful search will assuredly yield him a most abundant return."

The locality of Long lake and the season offered but few flowering plants for the attraction of insects. The collections, therefore, were mostly confined to golden rods (*Solidago*) and the hard-hack (*Spiræa tomentosa*), which were freely visited by Hymenoptera, Diptera, and Coleoptera for the pollen that they afforded.

Of the Hymenoptera, the flowers were especially prolific in *Apidæ*, *Andrenidæ*, *Eumenidæ*, and *Crabonidæ*, whilst also yielding some desirable *Ichneumonidæ*.

In Diptera, several species of the gaily-colored *Syrphidæ* (flower flies) were abundant, of which, perhaps, the most interesting form was *Spilomyia fusca* Loew — a large fly, so singularly mimicking in size,

* *Seventh Annual Report of the Topographical Survey of the Adirondack Region of New York*, 1880, pp. 375–400.

form, color, and markings the common "bald-faced hornet," *Vespa maculata* Linn., as to be easily (and generally by other than entomologists) mistaken for it. The species had never come under my observation before, nor has it been recorded as occurring in the State of New York. Its first capture was made on the eleventh of August. It continued to increase in number, in both sexes, and the day prior to my departure from the locality (twenty-third inst.) it was more abundant than before. Over forty examples of the species were taken. Nothing, I believe, is known of its larval stage. Several examples of an interesting Conopid fly, *Physocephala furcillata* Williston, which had previously been taken only on the White mountains, were also captured on the *Solidago*. A large, globose-bodied Tachinid fly, *Echinomyia* sp., having its alulæ and basal portion of wings of a dull yellow, which I had in former years observed abundantly in Essex county, N. Y., was also a common visitor to the blossoms of the golden rod.

The collections in Lepidoptera were not large, the locality not being favorable to the multiplication of insects of this order. But few species of butterflies were seen, the following species being the only ones that were observed: *Colias Philodice* and *Pieris rapæ*, not abundant; *Danais Archippus*, abundant; *Argynnis Cybele*, *A. Aphrodite* and *A. Atlantis*, all in poor condition; *Argynnis Bellona*, not abundant; *Pyrameis Atalanta* abundant; *Satyrus Nephele*, rare; *Chrysophanus Americana*, very abundant, and frequent on golden rods; *Lycæna pseudargiolus*, rare, one example; *Vanessa Milbertii*, a few: no examples were seen of *Papilio*, *Grapta*, *Pamphila*, or *Nisoniades*. Of the above named, *Danais Archippus* (Fabr.) and *Pyrameis Atalanta* (Linn.) were so abundant in a field of buckwheat that three or four individuals could be taken in a single sweep of the net. Associated with them were numbers of one of the most brilliant and beautiful of our moths, *Plusia mortuorum* Guenée — a decidedly upland species. Its quick rise from the blossoms of the buckwheat, its rapid flight for a short distance, sudden dropping to the ground and running away to shelter, made it a difficult insect to capture. The elegantly marked *Homohadena atrifasciata* Morr., of which the first example taken in the Adirondacks in the year 1876, commanded in exchange with an enthusiastic lepidopterist, other insects of the value of fifty dollars, was taken from flowers of *Eupatorium purpureum*.

Coleoptera were not numerous. Several species of the pretty Lepturians were found upon the golden rods, and a single example of "the large and elegant *Leptura scalaris* Say," as characterized by Dr. LeConte (p. 313 of *Classification of the Coleoptera of North America*), now the type and only species of the genus *Bellamira*, was driven up

in a Solidago bordered road and taken upon the wing. It was seen under the same circumstances in other instances, and when in flight, and displaying the golden sericeous hairs clothing the tip of its abdomen, it resembled so closely a similarly tipped Asilus fly that it was mistaken for it. *Dicerca manca* LeC. (apparently not *tuberculata* of L. & G.—see *Trans. Amer. Ent. Soc.*, ix, p. 235), a rare Buprestid, was captured on the floor of the piazza of the Sagamore hotel.

Neuroptera, which should abound in the lake region, were few in number. The only species observed in abundance were the common *Polystœchotes punctatus* (Fabr.), of which hundreds could be seen resting on the parlor walls, and an Ephemerid, *Pentagonia vittigera* Walsh, on the slats of the window blinds and edge of the clapboards of the hotel.

About 1,000 insects were collected, mounted and labeled with locality and date of capture.

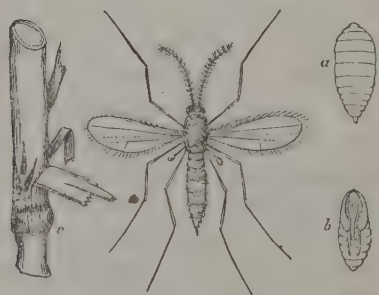

Fig. 45.—The Hessian-fly.

ACARINA AND MYRIOPODA.

A Mite Attack on Garden Plants.

Leaves of various garden plants showing a mite attack upon them were received in September, from Miss A. Goodrich, of Utica, N. Y., with the following note.

For two years past I have often found the leaves of the *Calla* covered with fine webs spun by a small mite. Last year garden plants were affected. Leaves turned yellow and flowers did not open. One root of *Spiræa* was almost killed. I put it in a pail of warm suds for the night, and planted it in a new place next day. This year it was not so badly attacked, but the sweet English violets and the *Thunbergia* in my window boxes suffered most. I tried hot water of 120° Fahrenheit, on the violets with success. I send specimens of the mite.

The mite is that frequent pest of garden plants and conservatories, *Tetranychus telarius* (Linn.), commonly known as the "red spider." It owes its popular name to its habit of spinning a web, and to the brick-red color which it sometimes assumes — the color which so often brings it under the notice of horticulturists. It may, however, present a great variety of shades of green, brown, and red, dependent to quite an extent upon its food-plants, although occasionally found to offer different colors upon the same plant. Fig. 46, after Claparède, represents it at maturity, greatly enlarged.

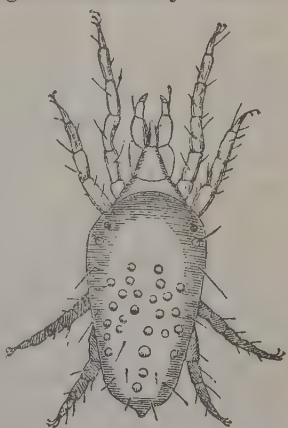

Fig. 46. — The "red spider," Tetranychus telarius — enlarged.

Although generally known as a spider, it is a true mite. In classification it stands next to the spiders, and at the head of the mites, in the family of the *Trombididæ,* which contains the most highly organized species of the Acarina. A distinction available in separating the mites from the spiders is that the former are without a pedunculated abdomen. The abdomen instead of being joined to a thorax by a narrow joint of attachment is united to the last of the leg-bearing segments without any well-defined groove of separation.

The webs which this species and its associates spin on the under side of leaves and adhering closely to them, are of an extremely

fine and delicate texture. A careless observer would not suspect their true character, but would pass them by as a simple sheen upon the leaf. The separate threads are so fine that they are not to be seen even by the aid of a magnifying glass, but are only visible when combined in an extended web. The silk is secreted from a minute nipple underneath the end of the abdomen. Beneath the web may often be found a large colony of the mites, embracing both old and young, in different stages of maturity, where, under this safe shelter, they are actively engaged in feeding upon the leaf. After biting with the mandibles with which they are provided, through the surface of the leaf, they insert the sucking apparatus and imbibe the juices Small as is each individual wound, the aggregation of the myriads soon tells upon the leaf and plant, which discolors, droops, turns yellow and perhaps dies under the attack.

It is unfortunate that this insect is so general in its food, for scarcely any tender garden plant is free from liability to its attack. In addition to the *Calla*, *Spiræa*, *Thunbergia* and violet, above-named, it was also present upon the leaves of *Mitella*, *Tropæolum*, *Adlumia*, and beans, sent with the inquiry. Their examination by Prof. Herbert Osborn, to whom they were submitted, showed the presence upon each of the same insect, in the egg, larval, and perfect stages.

This little mite, under favoring conditions, may multiply to an incredible extent, and become very injurious. A notable instance of this has lately been brought to my notice. Leaves of a quince tree infested by this species were sent to me for name, under date of August eleventh, by Prof. Arthur of the New York Agricultural Experiment Station, at Geneva. He reports the attack as occurring in one of the largest quince orchards in the State, about four miles from Geneva. The leaves upon many of the trees were like those received by me, which were nearly destroyed. The attack was rapidly spreading throughout the orchard, and the fruit upon the most seriously infested trees would be an entire loss.

Prof. Arthur was experimenting with the kerosene emulsion to kill the insect, but with what success has not been learned. Properly applied, it could not fail of accomplishing the purpose. A favorite remedy, long used in green-houses, is syringing with a soap solution in which sulphur is mixed. Quassia has also been thought serviceable when added to the mixture. It is quite important that the liquid be so applied as to reach the under surface of the leaves where the mites occur. It is worthy of note that in the above quince attack most of the mites were observable upon the upper side of the leaves.

The attack of this little mite is undoubtedly far more frequent than is supposed, for the reason that the creature can hardly be seen with the naked eye, and an ordinary pocket magnifier only shows it as an animated speck. A nasturtium in my garden, which had been for some time showing yellow leaves, or yellow blotches upon the leaves, without any apparent cause, was found, upon examination for this mite, to show its presence in considerable numbers, in the larval and in the adult stages. As an experiment, one of the infested leaves was dipped in water in which some soap had been stirred, with the result of speedily killing all of the mites upon it.

A Parasitic Mite of a Sexton Beetle.

Dr. S. A. Russell, of Albany, N. Y., has sent to me an example of one of the burying or "sexton beetles," *Necrophorus tomentosus* Web. (distinguishable from the other red-banded members of the family by the greenish-yellow down covering its thorax, and the two red bands crossing its wing-covers), thickly infested with a small red mite which runs with great rapidity. Several of them were sent to Prof. Osborn, who is making a special study of our mites with reference to a catalogue of the known species. At this present stage of his studies, he was only able to refer it to the genus *Gamasus*. He had previously obtained the same form from another species of *Necrophorus*.

Fig. 47. — The tomentose sexton-beetle, Necrophorus tomentosus.

[The catalogue — *A Preliminary List of the Acarina of North America*, by Herbert Osborn, of the Iowa Agricultural College, and Lucien M. Underwood, of Syracuse University — has been published in the *Canadian Entomologist*, for January, 1886, xviii, pp. 4–12].

A Parasitic Attack on the Colorado Potato-beetle.

From a gentleman in Middlesex county, Mass., some live potato-beetles, *Doryphora decemlineata* (Say), were received, to which were attached numbers of "bugs or lice," with the statement that he had found many of the dead beetles thus infested, and only a few live ones that were not attacked, and it seemed as if the beetles would all be killed.

The supposed lice proved to be a very interesting parasite which has been known for several years past to attack the Colorado potato-

beetle, and, as in the present instance, to render valuable service in reducing the numbers of this pest. Its principal interest, perhaps, is in the fact that, up to the present, only two or three true parasites of this beetle have been discovered among its thirty or more known natural enemies.

As an aid in the recognition of this parasite, it may be stated that they are quite minute forms, as five of them placed closely together would not exceed in surface that of the head of an ordinary pin. Their color is yellowish-brown, and in general shape they resemble many of the lady-bugs (*Coccinellidæ*), being oval, flat beneath and convex above. When examined with a microscope, they are found to possess eight legs, and this feature, of course, removes them from the lice and all other true insects, which have but six legs.

Their scientific classification places them among the Arachnoidea, in which are included scorpions, spiders, and mites. As their body consists of but one piece, instead of being made up of several segments, they fall in the last-named order, the mites (*Acarina*). This order embraces a large number of greatly differing forms that have been arranged in several families to include, as follows: The spinning and the harvest mites (*Trombididæ*), the snouted mites (*Bdellidæ*), fresh-water mites (*Hydrachnidæ*), parasitic mites (*Gamasidæ*), the ticks (*Ixodidæ*), the beetle-mites (*Oribatidæ*), the cheese-mites (*Tyroglyphidæ*), itch-mites (*Sarcoptidæ*), gall and bud-mites (*Phytoptidæ*), and others. The particular family to which this potato-beetle parasite belongs is the *Gamasidæ*, nearly all the species of which, in their wide distribution, live parasitically on mammals, fishes, birds, and insects. The common "chicken-louse," *Dermanyssus avium*, shown in Fig. 48, which is also found on caged canary birds, is a well-known species of this family.

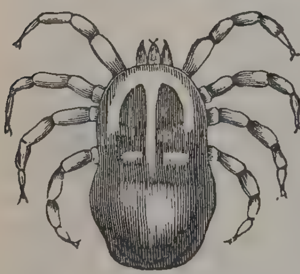

Fig. 48. — The chicken-louse, Dermanyssus avium — enlarged.

From examples taken from some Colorado potato-beetles in Ohio, in 1873, this little Gamasid mite was described and named by Professor Riley as *Uropoda Americana.* It was found to be closely allied to a species that had long been known to infest beetles in Europe — the *Uropoda vegetans,* having the same habit of attaching itself to its host by a chord or filament, one end of which was fastened to the anal end of the mite and the other to the beetle. Many had been the surmises of the nature and object of this singular attachment in the European species. Some of the old writers had regarded it as a kind

of umbilical cord through which the mite drew its sustenance from its host, and others, that it was a silken thread spun by the mite to serve to fasten it and to prevent its being brushed off by the motions of the limbs of the beetle. Close examination showed, however, that it had no organic structure, that it was fragile and became easily detached; and finally, a French naturalist, M. Dugés, ascertained that it consisted simply of the viscous and dried excrement of the mite, which could be removed and replaced at every new excretion.

The discovery of this parasite in Massachusetts in such abundance is gratifying. There is scarcely a doubt that the dead beetles reported as covered by the "lice," were killed by the attack. (The same attack has in former years come under my observation, near Albany, where the beetles were so infested that every portion of their surface, including their legs, was so covered as to leave room for no additions unless they could be superimposed.) When received, although still upon the potato leaves, they were not feeding, but were evidently greatly debilitated and near their end. The occurrence of the parasite so early in the season (May) is also favorable, for every beetle now destroyed should serve to lessen the number of the pest that would have appeared later in the year by several hundreds. The present brood of beetles will be followed by at least one other during the year, and each female continues to deposit eggs, from time to time, during the five or six weeks of her natural life, until about a thousand have been deposited.

Our correspondent might render excellent service if he would inform himself whether this parasite is to be found in other localities in his vicinity, or in other portions of the State; and if not so found, if he will distribute the infested beetles and so extend the sphere of operations of the serviceable little mite. It would be necessary that they be sent attached to the beetle, as they die very soon after being separated from their host. If some of the potato leaves are put in the box with the beetles when packing them for transportation, there would be less liability of the mites being rubbed from them in transit.

The Cheese-mite Infesting Smoked Meats.

Tyroglyphus siro (Linn.).

From C. H. Wessels, provision broker, New York city, some pieces of smoked ham were received in June [1885], which were infested with myriads of a small white mite. Inquiry was made as to their nature and origin, and for some safe and effectual method of dealing with

them. No attack of the kind had previously come under the observation of Mr. Wessels, or of those engaged in the same trade with whom he had conferred.

Upon critical examination they were found to be identical with the common cheese-mite, *Tyroglyphus siro* (Linn.), a species which, although frequently occurring in vast numbers in cheese, has long been known to thrive equally well on several other articles of food. It is not at all uncommon in flour, and when observed therein by Linnæus, he presumed it to be a distinct species, and named it *Acarus farinæ.* When the same insect came under his notice in milk, it was designated by him as *Acarus lactis.* From unusual features presented in some examples, it was named and figured by De Geer (vol. 7, pl. 5, fig. 15) as *Acarus domesticus,* when he had found it occurring in meal, sugar, and smoked meats.

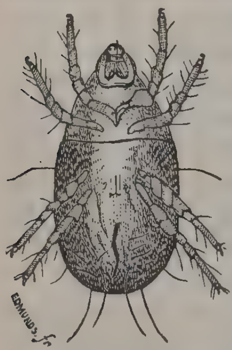

Fig. 49. — The cheese-mite, Tyroglyphus siro — enlarged.

This insect had not been previously known as infesting meats in this country,* although a closely allied species, *Tyroglyphus longior* Gervais, as identified by Professor Riley, had been found in a pork-packing house in a western city, in such abundance as to form layers of half an inch thick in places, beneath sacks of fertilizing material piled upon the floor, composed of livers, lungs, and kidneys, after they had been cooked and dried by steam (*American Naturalist,* xvi, 1882, p. 599). This latter species is distinguishable from the cheese-mite (according to Murray) by its more rapid movements, larger size, longer and more cylindrical body, and more shining hairs sticking out on every side. The habits of the two are said to be much the same, and it is of interest that in a small bit of the infested ham received by me that was sent to Prof. Riley, he identified an example of *T. longior* associated with *T. siro.* The two have been also found in association on old cheese, but *T. longior* in by far the smaller proportion — in but eight per cent upon some Rochefort cheese, and only one per cent on Septmoncal. It is this species which, about half a century ago, enjoyed for a time the notoriety of having been brought into being as a human creation through the electrical experiments of Mr. Cross, named at the time as *Acarus horridus,* before its identity with *T. longior* had been ascertained.

As the origin of the mites occurring upon the ham could not be readily answered, inquiry was made of Mr. Wessels as to the source of the meat, its method of curing, and for any other information that

* See subsequent notice of the same insect infesting smoked meats in Everett, Pa., in *Fortieth Rept. N. Y. St. Mus. N. H.* for 1886. p. 130.

might be pertinent to the question. The following communication was returned:

Replying to yours of the tenth of June, we would state that the hams in question are cured in the western part of Ohio, and in a brine made of salt, saltpetre, and sweetened either with sugar or syrup. They are packed fresh from the animal in tierces, the brine poured in and the package closed — the meat being then left to cure, a process requiring from forty to sixty days, although they remain in this condition from one to twelve months. They come east in that shape and are here taken out of pickle as they are wanted, and smoked. The dipping of which you inquire, is never done to packed hams, but only to bagged or canvassed hams; and is done that the coating may protect them from the deposit of eggs by flies. The smoking that we gave them was not to exterminate the pest, but to prepare them for market. It had, however, no effect upon the insect except to make it more easily discernible. The attack seems to be increasing rapidly, through germination or some other process.

From the above statement, it seems probable that the mites had their source in the establishment in which they were packed — an infested pork-packing house, as in the instance above cited. As a remedy, simple, inexpensive and probably effectual, recommendation was made to Mr. Wessels of dipping the meat in a weak mixture of carbolic acid and water. Used in the proportion of one part of the acid to 100 parts of water, it would, with scarcely a doubt, destroy the mite, not injure the meat for food, nor would the creosotic odor of the carbolic acid impart a disagreeable smell to it.

Before venturing to recommend the above wash for a meat which is sometimes partaken of in an uncooked state, the opinion of Dr. Willis G. Tucker, the distinguished chemist of the Albany Medical College, was asked, and the following answer received:

Yours, concerning use of carbolic acid for destroying flour-mites on ham, is at hand. The internal dose of the acid is about one grain (or one drop of the diliquesced crystals) for an adult. In large enough quantity or a sufficiently concentrated state, it is a caustic, escharotic, and violent poison. It must be used with care, and I would suggest the possibility of its affecting the salableness of the hams, for its odor, slightly different from creosote, might prove objectionable. It is soluble in twenty parts of water. A strength of one to 500 is said to instantly destroy vegetable mold, both plant and spores, and to operate with equal destructiveness upon microscopic animalculæ. Hobbescyler says that all inferior organisms perish in a solution of one to 100. It is used at about this strength to kill the itch-insect, body-lice, etc. I would suggest trying a solution of this strength (1 to 100) or say an ounce to a gallon (1 to 128). If this should be effectual, I do not see how it can hurt the meat, and it certainly would be perfectly safe. If this does not kill the mites, then I would try double the strength.

The Cheese-mite Infesting Flour.

The following communication was submitted to me from a correspondent at Robin's Nest, Ill.:

A few days since a neighbor sent us a pan of wheat flour with the request that we examine it. Setting the pan in a quiet place for twenty-four hours, the surface presented a strange appearance — only comparable to that of an ant-hill — as though each grain was being separately moved. Slightly disturbing this surface and examining through a common sun-glass of low power, it was found to be full of very minute life. Taking a few particles from the mass upon the point of a penknife, and placing within the focus of a botanical glass, at least a half dozen lively little insects were to be seen. They somewhat resembled plant-lice in form, were white, evidently soft-bodied, and were covered with hair, possessed of two antennæ and six legs of a reddish-brown color. An apparent nest, from which a dozen or more would crawl forth, was not larger than the point of a small pin. It is much to be regretted that there was not a proper microscope at hand so that a more extensive examination might be made. Now, what are they — name, family, genus, and history? Where do they come from, and what are they doing in thus desecrating the staff of life?

Reply was made, substantially, that the insect was doubtless an Acarus, or mite — one of the family of the *Acaridæ*, which comprises the mites properly so called. The species could not be determined from the above description, but the conjecture was ventured that the critical examination of specimens would show it to be, if not the *Tyroglyphus siro*, well known in Europe as frequently infesting old flour (since its identity with the *Acarus farinæ* of Linnæus has been established), then a closely allied species of that genus.

In appearance it would probably bear a close resemblance to *Tyroglyphus sacchari*, or the sugar-mite, which occasionally may be found swarming in raw sugars, looking like minute white specks scattered throughout it. (The *mature* insects should have eight legs instead of six, as above stated.) As an illustration of the abundance in which these food-infesting mites may occur, it may be of interest to state that in an examination of sugars, instituted several years ago in London, England, to see to what extent the *T. sacchari* infested this material, its presence, in a living condition, was detected in sixty-nine out of seventy-two samples examined. In one sample of an inferior quality, from the number actually contained in one grain's weight, the computation was made that one pound of the sugar contained a hundred thousand of the mites. In the flour above referred to, it is probable that they were even more abundant than in the sugar.

Perhaps no satisfactory explanation can be given of the presence in such numbers of the mite in the flour, nor is it known to what extent

it occurs in the flour of our markets. If the species has been introduced in any flouring mill, then we can readily see how a few specimens could find entrance into many, or most, of the barrels sent therefrom. Although the insect multiplies in almost incredible rapidity, yet, in consideration of the ordinary ready sale and quick consumption of our great staple, it would not ordinarily increase to a sufficient extent to attract attention. If permitted to remain for several months before it is used, until it becomes *old flour*, it might easily become in a condition to be properly characterized as *alive*.

Of course it would not be at all agreeable to know that our vegetable diet was so highly charged with animal matter. Yet, as the intrusion is not of foreign material, but of elements scarcely changed — little other than transformed — we need not be deterred from partaking with our usual zest of the fresh wheaten loaf that graces our board, by the thought that, perchance (without our knowledge), a hundred thousand lives had paid tribute to its production.

Food of Cermatia forceps Raf.

In the notice of this Myriapod contained in my *Fourth Report on the Insects of New York*, it is stated that it had shown itself so remarkably sensitive to confinement, that upon all the occasions that it had been brought to me alive, it had invariably died within two days thereafter. The question was asked — can it succumb so quickly for want of its proper food, or to need of moisture? The question has been answered in some experiments made by Miss L. A. Marshall, of the Industrial School of Albany, who, becoming interested in its habits, had kept an example under observation for a period of over three months in an ordinary drinking glass with a piece of thin muslin bound over its top. It was daily supplied by her with three or four drops of water, which were taken with apparent avidity. If the drops clung to the lower surface of the muslin, it would ascend the side of the glass to get them as they hung. It had also been given occasionally small flies and young croton-bugs, which it ate, and in one instance it was seen to eat a young individual of its own species.

That the Cermatia is dependent upon at least a daily draught of water would appear from the fate of a specimen which Miss Marshall had brought to me for my personal study after having been in her possession for some weeks. It had been placed in a muslin-covered glass and given as much water as it would accept. The following day being Sunday, it was not visited at my office. On the morning thereafter it was found lying dead in the jar.

More direct evidence of this insect being a fly-feeder has lately been communicated to me by Professor S. A. Forbes. He had learned from a very intelligent lady teacher of Golconda, Ill. (on the Ohio river), that the Cermatia had been very abundant a few years ago, at her house on an island in the river. It had been for some time a constant terror to the household who supposed it to be dangerous and poisonous, but later it became famous among them as a fly-killer, devoting itself entirely to the pursuit of house-flies, of which it was so greedy that it would sometimes hold one, or even two, while it caught a third, and devour each in turn.

Julus cæruleocinctus beneath Carpets.

Mr. W. G. Warren, of Buffalo, N. Y., sends (in April) examples of this common myriapod which he had found in the corners and under the border of the carpet — a heavy Moquet — in his drawing-room. They were apparently confined to the extreme edge of the carpet, near the walls. They had not occurred in any abundance. Ten examples were sent for name. An enlarged figure of it is given above.

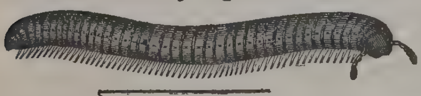

Fig. 50.—Thousand-legged worm, Julus cæruleocinctus — enlarged.

A lady residing at Loudonville, Albany county, N. Y., has also discovered the same *Julus* under similar circumstances. Specimens were sent, in October, with the inquiry if they had any connection with the carpet-beetle, for since she had been troubled with that pest, these had been found quite frequently and usually in association with the beetle. In May of the following year, after the house had been closed during the winter, additional examples were sent me in compliance with request, with the statement that they were all that were found on the opening of the house. The broken pieces indicated about ten specimens.

No reason is known for the intrusion of these creatures in the localities where they are above reported. If drawn thither for food, the nature of their food under such circumstances is an interesting inquiry.

Although not belonging to the insects proper, this myriapod is frequently submitted to the entomologist and information of it requested.

[See notice of "A Severe Attack on Potatoes" by this myriapod in the *Report of the Entomologist for the year* 1886, p. 131 — 40th St. Mus. Rept.]

APPENDIX.

(A.)

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST.

The following is a list of the principal publications of the Entomologist during the year (1888), giving title, place and time of publication, and a summary of contents. Lists of publications during 1884 and 1885, taken from the reports of the Entomologist to the Regents of the University S. N. Y., for the years 1884 and 1885 (of which only the State Museum and Documentary editions were published) are appended:

Egg-laying of Peach-Borer Moth.* (Country Gentleman, for February 9, 1888, liii, p. 109, c. 3 — 32 cm.)

In reply to an inquiry from New Jersey of the length of time that the moth is on the wing, it is stated that a satisfactory answer can not be made, even for that State — much less for different States of the Union. Observations of Drs. Harris, Fitch, Packard, Kellicott, Prof. Cook, and Mr. Saunders, are quoted, which seems to indicate that the period for oviposition in New Jersey may extend from the first week in June to the middle of September. During this time preventives should be used.

Some Pests of the Pomologist. From the American Pomological Society's Report for 1887. Read before the A. P. S. at its Boston meeting, September 15, 1887. (Separates, 4to, with cover and title page, 13 pp.) Published March 1, 1888.

The paper presents the following headings: Progress in Pomology; Evils attending Progress in Pomology; Need of Scientific Study; Demands of Science on the Pomologist; Immense Fruit Production — no Overproduction; Large areas devoted to Fruit Crops; Increase in Plant Diseases; Increase of Insect Ravages; Food-habits of Insects; Change of Food-plants; Introduction from Abroad; Spread of Scale Insects; Number of Insect Pests; An Unknown Currant Insect; How Insect Ravages are to be Met; Insecticides; Publications relating to Fruit Insects; Conclusion.

[Published, also, in the *Fourth Rept. Ins. N. Y.*, 1888, pp. 183–192.]

Remedies for Scale Insects. (Country Gentleman, for March 1, 1888, liii, p. 169, c. 2–3—34 cm.)

Apple and pear trees infested with "white scale," at Perryman, Md., became nearly free from them after lady-bugs had been collected and placed on them. Previous washes of lye, potash, lime, and gas-tar seemed to be ineffectual. Inquiry is made if the lady-bugs may be credited with the result.

* The capitalization, etc., of the *Country Gentleman* is followed herein in the citation from it of titles of publications.

The scale insect is *Chionaspis furfurus* (Fitch). The washes named should have destroyed it; in all probability they aided largely. Lye, soda, and potash washes are valued as very effective against the scale insects of California. Formulæ for two of the washes are given. "Heavy oil" from W. Virginia recommended for scales. Some of the lady-bugs are very efficient in destroying them, as *Chilocorus bivulnerus*, *C. cacti*, and species of *Scymnus*. Entomological knowledge would be needed for their collection in sufficient quantities for the purpose.

[Injurious Fruit Insects of the Vicinity of New York.] (Proceedings of the New York Farmers: 1886–87, pp. 52–59.) Published March, 1888.

Following some remarks on the aid that may be given to agriculture by economic entomology, its consequent importance, its commencement within recent times, its progress, and the high position it has attained; also, on the great increase of fruit insects and the causes therefor — the following insects are noticed and best remedies for them given: The apple-maggot (*Trypeta pomonella*); the apple-worm of the codling-moth; apple-tree aphis; bark-borers (*Xyleborus pyri*, and *Scolytus rugulosus* and *S. obesus*); plum-curculio; peach-tree borer; eight-spotted Alypia on grapevines; currant-worm; cabbage-butterfly (*Pieris rapæ*); and the Colorado potato-beetle.

Sulphur for the Elm Beetle. (Country Gentleman, for March 15, 1888, liii, p. 209, c. 2–3 — 30 cm.)

A notice in the New York Sun (copied) states that Mr. Dodd, of Orange, N. J., claims to have demonstrated that the attack of the elm-leaf beetle on elm trees can be thwarted by placing sulphur in one-inch augur holes bored in the sap wood five inches apart around the tree. Comment on this is made that the inefficacy of this method of protecting foliage, first announced sixty-six years ago, has often been shown. Sulphur could only be taken in the circulation when dissolved, and it is not soluble in sap. It has been found, unaltered, in plugged cavities of trees five years after insertion. It is doubtful if sulphur, if dissolved, would prove injurious to insects. Some experiments made by Dr. Fitch (given) indicate that it promotes their vigor and growth. [See page 240 of this Report.]

The Pea Weevil. (Country Gentleman, for March 22, 1888, liii, p. 229, c. 1–3 — 68 cm.)

The operations of the grub in the pea are described. It is a true weevil, belonging to the *Chrysomelidæ*. Description of the beetle is given, and its distribution in the United States and Europe stated. It has been very abundant in Canada. The eggs of the beetle are deposited on the pod, through which the larva burrows to reach the peas. Green peas containing the young larvæ may be safely eaten. Remedies and preventives are these: Keep the peas in a warm place, when the beetles will prematurely emerge in autumn, and die before they can oviposit the following season. They may be killed by dropping the peas in hot water for a minute, or by exposing them to camphor or kerosene, or by bisulphide

of carbon (manner stated). Plant no weevil-eaten peas. For severe weevil attack, stop cultivation throughout the infested district for a year. Late planting, from June first to tenth, is believed to be a preventive of attack.

The Elm-Leaf Beetle. (Country Gentleman, for March 29, 1888, p. 249, c. 2–3 — 20 cm.)

To inquiry from New Jersey of the best protection from the beetles, and how early the remedies should be used, reply is made that London purple, one pound to 200 gallons of water, with eight quarts of flour (prepared as directed), should be applied with a force-pump, fitted with a "cyclone nozzle," or one of the finest "Nixon nozzles," in a fine spray or mist. For high trees, the nozzle may be applied to the end of a long hose, tied, for elevation, to a bamboo rod." The tallest elms should be sprayed from the principal branches, by carrying into the tree a longer hose or a portable spraying apparatus. Spray as soon as the deposit of eggs is commenced—in New Jersey early in June. Repeat in a fortnight if necessary. [See pp. 239, 240 of this Report.]

Our Worst Enemies — The Bugs. (Country Gentleman, for April 5, 1888, liii, p. 269, c. 1–2 — 38 cm.)

In the subject as announced for remarks at the Chatham, N. Y., Farmers' Institute, bugs must be accepted, in popular American usage, as including all orders of insects. They may be regarded as the worst enemies of the agriculturist, for these reasons: They are so numerous, so prolific, so ravenous, such epicures, so wasteful, so small, so omnipresent, so secret, so regular in occurrence, and have such wonderful instincts for finding their food-plants and for self-protection.

They are to be fought by making their acquaintance through observation and the published literature, and learning of the best insecticides and how to apply them; what these insecticides are, and instruments used with them. Importance of the study of economic entomology urged, and coöperation in it solicited.

The Striped Flea Beetle. (Country Gentleman, for April 12, 1888, liii, p. 289, c. 1–3, figure — 64 cm.)

The insect, *Phyllotreta vittata* (Fabr.) is described and figured in both larva and imago. For killing the larva among the roots of its food-plants, solutions of pyrethrum, soap and carbolic acid, tobacco water, and kerosene emulsion may be used. For preventives of egg-deposit, strongly odorous substances, as kerosene mixed with sand, gas-tar on sticks or corn-cobs, tar water, drainage from pig-styes or the manure. Popular measures are dusting with lime, soot, ashes, snuff, tobacco dust, sulphur, and plaster. Dr. Fitch, of these, found ashes the best, as in experiments cited. He also recommended keeping young chickens and toads in gardens for hunting the beetles. Paris green or London purple sprayed over the young plants may be the best way to kill the beetle. Pyrethrum powder has been found effective.

Unrecognized Apple-Tree Attack. (Country Gentleman, for April 26, 1888, liii, p. 329, c. 2, — 17 cm.)

The injury to limbs of an apple tree, received from Mercer Co., N. J., can not be referred to any known insect. The first year's attack shows a small hole surrounded by blackened and dying bark, leading to an elongate empty egg-shell within the bark in a cyst-like cavity. No larval channel therefrom into the bark or wood is present. The second year after attack shows an unsightly scar of an inch or more in diameter, from which all the sap-wood is removed, with a new growth impinging on its border. The old bark is either removed from the dead wood beneath, or still held as a dried and depressed film over it. [Was subsequently referred to the oviposition of one of the flower-crickets.]

The White Flower-Cricket. (Country Gentleman, for April 26, 1888, liii, p. 329, c. 2–3 — 12 cm.)

Egg punctures in a Concord grapevine of a size as if made by a pin, arranged closely together in continuous, almost straight lines of two or three inches in length, are identified as those of *Œcanthus niveus* (Serv.). These punctures may kill the vines beyond them or cause them to die and break off. The insect does not feed upon any of the numerous plants in which it oviposits, but is carnivorous in its early life, eating plant-lice, etc.

The Leaf Hopper. (The Vineyardist, May 1, 1888, v. ii, p. 113, c. 1–3 — 81 cm.)

Remarks on the comparative injury caused by *Erythroneura vitis* on different varieties of grapes; its habits and nature of its injuries, description, and transformations; not a "Thrips," and what the *Thrips* is. The best remedy for it in graperies is vaporization of tobacco juice; how it is done in France. For destroying it in vineyards, spray the larvæ with tobacco water or soap-suds, or kerosene emulsion. Driving the winged insect on strips of tarred building-paper, stretched and carried between the rows of vines, has proved efficient.

To Kill Plant-lice. (Farm and Home, for May 1, 1888, ix, p. 158, c. 4.)

Plant-lice on apple trees are not difficult to kill, if attacked at the right time, with the proper apparatus and in the right manner. The proper time is early in the spring when they are hatching and before they are protected by the curling leaves, or when they are in the egg in the autumn, by spraying with a kerosene emulsion. The needed apparatus is a good force-pump and nozzle — the best of these are named. The right manner of applying the insecticide is to make it reach every insect; benefits of fine spraying stated.

[Revised, and printed in this Report, pp. 160–162.]

The Bacon-beetle attacks Comb. (The Bee Keepers' Magazine, May 1888, xvi, pp. 143, 144 — 62 cm.)

A beetle sent for name, the larvæ of which had attacked some empty honey-comb and riddled the wax, is *Dermestes lardarius* Linn. Its habits are given, together with those of some allied species, and the larva and

beetle described. This is the second recorded instance of its feeding on wax. In Europe wax is sometimes eaten by insects — possibly by this species.

Elm Leaf Beetle. (Country Gentleman, for May 10, 1888, liii, p. 366, c. 3-4 — 13 cm.)

Identification of *Galeruca xanthomelæna* from Scarsdale, N. Y., and in answer to inquiries, reference is made to notices in the *Country Gentleman*, giving full information of the insect, the principal of which are these: October 12, 1882, p. 805; October 15, 1885, p. 841; May 27, 1886, p. 409; May 26, July 21, and September 8, 1887, pp. 421, 565, and 695; March 20, 1888, p. 249 — the last giving full spraying directions.

Friends, not Foes. (Country Gentleman, for May 31, 1888, liii, p. 430, c. 3 — 13 cm.)

Small beetles sent from West Newton, Pa., as injurious in hot-beds to flower-plants, etc., by destroying the fibrous roots and thereby killing the plants, are of two species, neither of which can cause the injury of which complaint is made. *Tachus incurvus* Say, is one of the predaceous *Carabidæ*, and it is known to eat other insects. *Homolota lividipennis* Mann., is one of the *Staphylinidæ*, a family of useful insects which serve as scavengers of decaying vegetable and animal matter.

Maple-Leaf Mite-Gall. (Country Gentleman, for June 14, 1888, liii, p. 460, c. 4 — 14 cm.)

Leaves of soft maple sent from Suffolk county, N. Y., are one-third covered with wart-like elevations of about the size of the head of a common pin, which are caused by the leaf-mite, *Phytoptus quadripes* (Shimer). The formation and appearance of the gall is described, and burning the infested leaves or spraying with a tobacco solution the latter part of June is recommended.

A Grapevine Pest. (Orange County Farmer, for June 21, 1888, vii, p. 5, c. 1 — 15 cm.)

The galls of *Lasioptera vitis* O. S., identified on the leaves and tips of a Muscadine vine, from Port Jervis, N. Y. Description of the gall, the insect that produces it, the contained larva, its escape from the gall and subsequent transformations. Removal and burning of the infested leaves and tips the best preventive of future attack.

Cockscomb Elm-Gall. (Country Gentleman, for June 28, 1888, liii, p. 496, c. 1 — 10 cm.)

The galls sent on the "weeping slippery elm," from Charlottesville, Va., are described and identified as those of *Colopha ulmicola* (Fitch), and reference for a more extended notice of them, made to the C.-G. for September 23, 1886, p. 713. The gall, thus far, has only been recorded on the white elm, *Ulmus Americana*, and the leaves sent seem to be of that species.

[See, also, *Glyphina ulmicola*, in *Fortieth Rept. N. Y. St. Mus. N. H.*, 1887, pp. 126-128.]

Apple-Tree Tent-Caterpillar: Clisiocampa Americana. (Country Gentleman, for July 5, 1888, liii, p. 511, c. 2, 3 — 28 cm.)

The best preventive of the injuries of this pest is the removal of the belts of eggs, which may be easily done when the trees are leafless. The next best is to destroy the nest with its occupants as soon as it can be recognized in the forks of the branches. The caterpillars may be poisoned by spraying the foliage with one pound of London purple in 200 gallons of water. The amount of harm done by this insect is in diminishing the yield of fruit and its quality in proportion to the amount of defoliation. The abundance of the insect the present year in this State has been phenomenal, nothing approaching it having been previously observed. For this no satisfactory cause can be assigned.

Honey-Dew on Hickory Leaves. (Country Gentleman, for July 5, 1888, liii, p. 511, c. 3 — 16 cm.)

Hickory leaves, apparently of *Carya alba*, received from Clarksburg, W. Va., are thickly coated, on their upper side, with "honey-dew." Several species of Aphides are known to secrete this material, but in some instances it results from a diseased condition of the leaves, causing the excretion of a honeyed substance. In this case it is thought to have been excreted from the leaves, for reasons stated. Reference is made to *Lachnus caryæ* occurring on the pig-nut, *C. porcina*.

Grape-Leaf Galls. (Country Gentleman, for July 5, 1888, liii, p. 511 c. 4 — 8 cm.)

Galls on a Rogers' seedling, from Worcester, Mass., are identified those of *Lasioptera vitis*, the larva of which is briefly noticed. The best preventive known of this attack is to remove and burn the infested leaves and tips during early June, before the larvæ leave them for their further development in the ground.

A New Pest Threatens the Hay Crop. (Albany Evening Journal, for July 7, 1888, p. 7, c. 3.)

A correspondent from Delmar, Albany county, N. Y., writes of a minute insect infesting the base of the upper joint of Timothy grass, and arresting its development. From examples submitted, it proves to be a species of *Thrips* which may be identical with that which has long invested June grass (see Report of Entomologist for 1886, in 40th Rept. St. Museum Nat. Hist., pp. 96–98), but being at present in the larval stage, can not be determined.

Stalk-borer. (Country Gentleman, for July 12, 1888, liii, p. 532, c. 1–2 — 16 cm.)

A larva from Rock Hall, Md., where it is known as the "bud-worm," and is infesting young corn by burrowing downward into the stalk, is identified as *Gortyna nitela* Guenée. Distinguishing features of it are given, vegetation that it attacks, and the best remedies for it. Reference is made to other notices of the insect.

An Entomological Friend. (Orange County Farmer, for July 12, 1888, vii, No. 45, p. 8 — 12 cm.)

An insect sent for name from Port Jervis, N. Y., as destructive to the plum crop, by eating into the fruit, is identified as the harmless 15-spotted lady-bug, *Anatis* 15-*punctata* (Oliv.). [The parti-colored singular looking pupæ, fastened to the fruit, were probably mistaken for excremental matter thrown out by borers within.] The service rendered by the insect is stated, and the importance of its protection.

The Ash-Grey Blister-Beetle. (Country Gentleman, for July 19, 1888, liii, p. 547, c. 2–3 — 47 cm.)

Beetles very destructive to the foliage of potatoes at Charlottesville, Va., are *Macrobasis unicolor* (Kirby), one of the four common species of blister-beetles of the Northern and Middle United States. Their blistering properties are referred to and compared with that of the imported Spanish fly, *Cantharis vesicatoria*, a notice of which is given. *M. unicolor* is described and its habits and food-plants stated. Recent study of our blister-beetles is mentioned, and observations which have shown them to possess carnivorous habits. A remedy is found in Paris green; preventives in lime, plaster, or road dust.

Insects on Apple Trees. (Country Gentleman, for July 19, 1888, liii, p. 548, c. 1 — 8 cm.)

Insects sent from Norfolk, Va., and represented as causing the so-called "black knot" on apple trees, particularly on the "Early Harvest," can not have caused the injury complained of, as one is the apple-worm of the codling-moth, and the other an unknown Lepidopterous pupa. What is commonly known as the "black knot," does not occur on apple trees, and what this "knot" on the apple trees is, can not be told without examination of specimens.

The Light-Loving Grapevine-Beetle. Anomala Lucicola. (Country Gentleman, for July 26, 1888, liii, p. 565, c. 3–4 — 23 cm.)

Beetles from grapevines at Hightstown, N. J., are *Anomala lucicola* (Fabr.). Their general features are given and colorational characters which apparently indicate the sexes. Instances are narrated of their fondness for, and injuries to, the foliage of the grapevine. Preventives of attack are dusting the leaves with air-slacked lime. Spraying at night when collected on the vines, with pyrethrum water, should be serviceable.

The Black Long-sting. (New England Homestead, for August 4, 1888, xxii, p. 286, c. 5 — 30 cm.)

Thalessa atrata (Fabr.) is described and illustrated in a figure from Harris' Insects Injurious to Vegetation. It and *T. lunator* (Fabr.), in their larval stage, feed externally as parasites on the larva of *Tremex columba* within its burrows in maple, elm, etc. They are usually to be found associated with Tremex attack, and are very serviceable in its [illegible] st.

A Grapevine Caterpillar — Thyreus Abbotii. (Country Gentleman, for August 19, 1888, liii, p. 599, c. 2–4 — 43 cm.)

A caterpillar taken from the "common ivy" is sent, with inquiry, as "a revolting specimen" of insect life. Its common food-plants are grapevine and Ampelopsis or the woodbine — the latter probably the "ivy" named. The principal features of the moth and of the dimorphic forms of the larva are described: The form marked by the large, yellow, subquadrate spots is far from "revolting." No cause can be assigned for these two quite distinct forms, which are not sexual, seasonal, or dependent on food. The white color and the caudal horn of the young larva are referred to, also the contortions, when disturbed, of the adult. Absurd ideas of the poisonous nature of these Sphinx larvæ are quoted.

The Spittle Insects. (New England Homestead, for September 15, 1888, xxii, p. 333, c. 1–2 — 34 cm.)

Insects on grass in a substance resembling spittle, at Auburn, Mass., are Hemiptera in their larval stage, of the group known as "spittle-insects." The "spittle" is produced, according to Uhler, by expulsion from the beak, while observations of DeGeer are quoted on its expulsion from the anus. Different species are named and their food-plants given. In Vermont they have seriously damaged the hay crop, but they seldom occur in injurious numbers.

[For notice of these insects, see pp. 243–246 of this Report.]

Fly on the Heads of Cattle. (Country Gentleman, for September 20, 1888, liii, p. 705, c. 4 — 10 cm.)

Inquiry is made from Hamilton Square, N. J., of a fly which is exciting much interest and anxiety from its reported habit of boring in the horns of cattle and depositing an egg, the grub from which burrows into the brain and causes the death of the animal. Nothing is known of such an insect. If such existed, it and its habits would have been known to entomologists. It would, therefore, not be worth while to coat the horns with tar, as is being done, for a preventive.

[For notice of this insect, see pp. 220–227 of this Report.]

The Melon Plant Louse. (Country Gentleman, for September 27, 1888, liii, p. 725, c. 2–3 — 30 cm.)

Muskmelon leaves sent from Lowell, Mass., as showing destruction of the crop when about half-grown, are infested with a plant-louse which seems to be *Aphis cucumeris* Forbes. The aphis is described, and its history given, and a notice of a parasitic attack upon it in Illinois. Some shoots of the plants also sent have been transformed into galls which have disclosed a Cecidomyia. If undescribed, it may be named as *Cecidomyia cucumeris*.

The Hag-Moth Caterpillar. (Country Gentleman, for September 27, 1888, liii, p. 725, c. 3–4 — 17 cm.)

A caterpillar found on an apple tree at Buckner's Station, Va., is sent as an example of mimicry in insects, from its resemblance to a dead and curled leaf. It is *Phobetron pithecium* (Sm.-Abb.), its common name

meaning a shriveled and monkey-faced old woman. Its singular appearance is described and its habits and food-plants given — the latter, apple, cherry, plum, and some of the forest trees.

[For an extended notice of this insect, see pp. 183–192 of this Report.]

An Ichneumonized Caterpillar. Interesting Case of Parasitism. (Country Gentleman, for September 27, 1888, liii, p. 725, c. 4 — 20 cm.)

A caterpillar taken from a hop-vine and sent from Wabash, Ind., for name and other information, is one of the Sphinges, too much changed for positive identification, but probably, *Darapsa Myron* (Cram.), a common gravevine-caterpillar which, after reaching maturity, may have wandered to hops. The cocoons covering its body were probably those of *Apanteles congregatus* (Say); but instead of giving out their Microgaster ichneumon, through a nicely-fitting hinged lid, a minute Chalcid had emerged from each cocoon through an irregular hole eaten in the side, presenting an interesting case of secondary parasitism. The Chalcid has not been determined.

Thousand-Legged Worms. (Country Gentleman, for September 27, 1888, liii, p. 725, c. 4 — 10 cm.)

Worms destroying geraniums by eating their roots, at Cape May, N. J., are *Julus cæruleocinctus* (Wood). These thousand-legged worms are difficult to kill when buried in the ground. Applications recommended are lime-water as strong as may be safely made, soot applied to the surface, and nitrate of soda to be followed by watering, or to be used in solution. Possibly quassia water might make the roots distasteful to them.

Bee-Keeper's Guide. (Country Gentleman, for September 27, 1888, liii, p. 727, c. 2 — 13 cm.)

Notices the *Manual of the Apiary* of Professor A. J. Cook, just published, in its thirteenth edition, which has been entirely rewritten, greatly enlarged, and much improved. Some of the new features introduced in this edition are noticed. It has been pronounced the best book on bees ever published.

Yellow-Necked Apple-Tree Caterpillar. (Country Gentleman, for October 4, 1888, liii, p. 743, c. 4 — 27 cm.)

Caterpillars sent from New York city, as devastating apple trees, are *Datana ministra* (Drury). The caterpillar is described, and its feeding habits, its injuries, its food-plants and its history given. Remedy — cutting off the branch on which the colony is clustered and crushing.

The Cow-Fly, Horn-Fly, or Texan-Fly. (Country Gentleman, for October 11, 1888, liii, p. 759, c. 2–3 — 36 cm.)

Examples of the cow-fly, noticed in the *Country Gentleman* of September twentieth, page 705, have been received from Kenneth Square, Pa. The species is unknown to me and is reported as unknown to the Entomological Department at Washington. It has been submitted to Baron Osten Sacken, of Germany. Its habits as gleaned from different sources are given. It seems to have been first noticed in Chester Co., Pa., in 1886.

Oak Galls. (Country Gentleman, for October 18, 1888, liii, p. 775, c. 2—7 cm.)

Small, round, pubescent galls, sometimes single, oftener confluent, on oak leaves (*Quercus* sp. ?) from Kingston, R. I., are identified as those of *Neuroterus verrucarum* O. S.—one of the *Cynipidæ*. No means are known by which these galls can be prevented. Their multiplication can be arrested by picking off and burning the leaves containing them, when not involving too much labor.

The Cow-Fly or Texas Fly. (Country Gentleman, for October 18, 1888, liii, p. 779, c. 2—7 cm.)

The fly is stated by Dr. Williston to be a species of *Stomoxys*, apparently undescribed and which he purposes to name *S. cornicola* [erroneously given as *cervicola*]. Now that it is known to be allied to *Stomoxys calcitrans*—a biting species with which we have been long familiar, the many stories of the serious and sometimes fatal injuries to cattle of this new insect, are effectually disproved.

Caterpillar on the Chestnut. (Country Gentleman, for October 18, 1888, liii, p. 786, c. 2—12 cm.)

Caterpillars sent from Rochester, N. Y., from a Spanish chestnut tree, are *Halesidota tessellaris* (Sm.-Abb.). The general appearance of the moth is given. The caterpillar feeds on several of the forest trees and is common on the sycamore. It has not been recorded from the chestnut.

The White Grub of the May-beetle. (Bulletin of the New York State Museum of Natural History, No. 5, November, 1888, pp. 31, figs. 5.) Reprinted, with additions, from the Forty-third Annual Report of the New York State Agricultural Society for the year 1883.

The following are the subheads of the paper: The White Grub.—The Egg.—Injurious Character of the Insect.—Injuries from the Grubs.—Injuries by the Beetle.—Life-History.—Distribution.—Its Enemies.—Preventives and Remedies.—Study of the Insect Desired.

[Published, also, in *Trans. N. Y. St. Agricul. Soc.*, xxxiv, for 1883–1886, pp. 5–33.]

Cut-worms. (Bulletin of the New York State Museum of Natural History, No. 6, November, 1888, pp. 36, figs. 28.) Reprinted, with additions, from the Forty-fourth Annual Report of the New York State Agricultural Society, for the year 1884–1885.

The contents are as follows: What are Cut-worms?—Their Appearance.—Their Habits.—Habits of the Moths.—Natural History.—Conditions Favorable to Cut-worms.—Their Food-plants.—Abundance of Cut-worms.—Literature of the Cut-worms.—List of Species.—Natural Enemies.—Parasites.—Preventives and Remedies.—Two Preventives specially Commended.

[Published, also, in *Trans. N. Y. St. Agricul. Soc.*, xxxiv, for 1883–1886, pp. 66–100.]

Red-Humped Apple-Tree Caterpillar. (Country Gentleman, for November 22, 1888, liii, p. 875, c. 2-3 — 26 cm.)

Caterpillars feeding in company on an apple tree in New York, are *Œdemasia concinna* (Sm.-Abb.). They are described, and their habits and range of food-plants given. From their gregarious habit, they should not be permitted to inflict serious injury on fruit trees. Orchards should be inspected from time to time during August, and as soon as noticed the branch containing the company should be cut and each individual killed.

A Familiar Pest. (New England Homestead, for November 24, 1888, xxii, p. 421, c. 1-2 — 12 cm.)

A pupa sent for name and other information is that of *Sphinx quinquemaculata* Haworth, the larva of which is known as the potato-worm. The moth that it produces, feeding habits of the "humming-bird moths," features of their caterpillars, the tongue-case of the pupa, the "tobacco-worm," and "worming tobacco fields" are remarked upon.

Fourth Report on the Injurious and other Insects of the State of New York [November 23], 1888, pp. 237, Figs. 68. (From the 41st Report of the N. Y. State Museum of Natural History, 1888, pp. 123-358.)

The Contents are: Introductory. Insect Attacks and Miscellaneous Observations [as follows]: The Insects of the Hemlock: The Chalcid Parasites of Cecidomyia betulæ: Isosoma hordei (*Harris*) — the Joint-worm Fly: Thalessa lunator (*Fabr.*) — the Lunated Long-sting: Amphibolips prunus (*Walsh*) — the Oak-plum gall Cynips: Aulacomerus lutescens *n. sp.* — the Poplar Saw-fly: Currant Bushes Girdled by an Unknown Insect: Orgyia leucostigma (*Sm.-Abb.*) — the White-marked Tussock: Lagoa opercularis (*Sm.-Abb.*) — the Rabbit Moth: Nephelodes violans *Guenée* — the Bronze-colored cut-worm: Homoptera lunata (*Drury*), as a Rose Pest: A Hemlock Leaf-miner: Cecidomyia balsamicola *n. sp.*, and its Gall: Lasioptera vitis *O. S.*, and its Galls.: Chloropisca prolifica *O. S. n. sp.*, and its Winter Gatherings: Phytomyza lateralis *Fallen* — the Marguerite Fly: Megilla maculata *DeGeer* — the Spotted Lady-bird: Chauliognathus marginatus (*Fabr.*) — the Margined Soldier-Beetle: Sitodrepa panicea (*Linn.*), as a Leather-Beetle: Xylotrechus colonus (*Fabr.*), occurring in a Dwelling: Haltica bimarginata (*Say*) — the Alder Flea-Beetle: Crepidodera rufipes (*Linn.*) — the Red-footed Flea-Beetle: Scolytus rugulosus (*Ratz.*) — the Wrinkled Scolytus: Corythuca ciliata (*Say*) — the Ciliated Tingis: Melanolestes picipes (*H. S.*) — the Black Corsair: Mytilaspis pomorum (*Bouché*) — the Apple-tree Bark-louse: Ptyelus lineatus (*Linn.*) — the Lined Spittle-hopper: Ephemera natata *Walker*, and other Ephemeridæ: Hair-snakes as Parasitic on Insects: Cermatia forceps (*Raf.*), as a Household Pest. Brief Notes on Various Insects: Dolerus sp.; Danais Archippus; Thecla strigosa; Nisoniades Persius; Sphinx Canadensis; Melittia cucurbitæ; Hyppa xylinoides; Erebus odora; Zerene catenaria; Anisopteryx pometaria; Tinea pellionella; Mallota sp.; Anthrenus scrophulariæ; Alaus oculatus; Thanasimus dubius; Macrodactylus

subspinosus; Lema trilineata; Chrysochus auratus; Trirhabda Canadensis; Galeruca xanthomelæna; Hylesinus opaculus; Phlœotribus liminaris; Belostoma Americanum; Ceresa bubalus; Chermes pinicorticis; Œcanthus niveus. Appendix. (A.) Some Extra-limital Insects: Carpocapsa saltitans *Westw.*, and its Jumping Seeds: Systena blanda (*Mels.*)—the Broad-striped Flea-Beetle: Leptocoris trivittatus (*Say*)—the Box-elder Plant-bug: Mantis Carolina *Linn.*—the Carolina Mantis. (B.) Entomological Addresses: The Present State of Entomological Science in the United States: Annual Address of the President of the Entomological Club of the American Association for the Advancement of Science: Some Pests of the Pomologist: (C.) List of Publications of the Entomologist during the Year 1887: (D.) Contributions to the Department during the Year 1887. (E.) Errata in Former Reports. General Index. Plant Index.

Identification of the Cow-Fly — Hæmatobia serrata. (Country Gentleman, for November 29, 1888, liii, p. 893, c. 2–3 — 20 cm.)

The fly, which has been the subject of former communications in the *Country Gentleman* and which Dr. Williston purposed soon to describe as *Stomoxys cornicola*, has been determined by Baron Osten Sacken, of Germany, to be identical with *Hæmatobia serrata* of R. Desv., of Southern France and Italy. Other generic references of the fly are given. [See notice of this insect on pp. 220–227 of this Report.]

Wire-Worms. (Country Gentleman, for November 29, 1888, liii, p. 893, figs. 1–6, c. 3–4 — 51 cm.)

To an inquiry from Potter county, Pa., for means of relief from excessive injuries from wire-worms, three of the best remedies are named and remarked upon at some length, viz., starvation, a crop of buckwheat, and a crop of mustard. As a guard against mistakes often made, the difference between wire-worms, cut-worms, and thousand-legged worms are pointed out and illustrated by figures.

Egg Deposits of Flower Cricket. (Country Gentleman, for December 6, 1888, liii, p. 911, c. 1 — 24 cm.)

Grapevine from Eaglesville, O., show egg-deposits on leaves (described) which have hitherto been referred to the white-flower cricket, *Œcanthus niveus* Harris; but there are reasons for believing them to be those of *Œ. fasciatus* DeGeer—a valid species, and not a variety of *niveus*. The remedy for the attack is cutting off and burning. Food-habits of the insect stated.

The grape leaf eating beetle of which inquiry is made, is *Pelidnota punctata* (Linn.)—remarks upon it.

White-Marked Tussock Egg-Clusters. (Country Gentleman, for December 6, 1888, liii, p. 911, c. 1–2 — 16 cm.)

The eggs on cocoons sent for name from Salem, N. J., are those of *Orgyia leucostigma* (Sm.-Abb.). The insect is pernicious. Its egg-bearing cocoons (these only) should be destroyed, and where they may be looked for. One of the cocoons gave out a parasite, *Pimpla conquisitor* Say.

Publications of the Entomologist During the Years 1884 and 1885.

A New Sexual Character in the Pupæ of Some Lepidoptera. (Psyche, iv, No. 115-116, November-December, 1883, pp. 103-106 — Issued February 11, 1884.) An abstract in Proceedings of the American Association for the Advancement of Science, held at Montreal, Canada, August, 1882, xxxi, 1883, pt. ii, p. 470-471.

Remarks upon the interest attaching to the sexual characteristics of insects; mentions a number of such sexual features; they are fewer and less marked in the earlier stages. The particular feature noticed in this paper is one pertaining to the *Cossinæ* and to the *Ægeriadæ*, viz., in the male, the *tenth segment* (not counting the head as one) is furnished with two rows of teeth, while the female uniformly has but one (as have the two following segments in each sex).

[Published in the *Second Report on the Insects of N. Y.*, 1885, pp. 213-217.]

A Horn-Tail — Urocerus Cressoni. (Country Gentleman, for January 3, 1884, xlix, p. 9, c. 1 — 11 cm.)

In reply to an inquiry from Perth Amboy, N. J., the species is named, and its affinities given, and its habits in the larval and perfect stages. It occurs in the Middle States, and interesting varieties have been recorded from Albany, N. Y.

Fuller's Rose Beetle — Aramigus Fulleri. (Country Gentleman, for January 17, 1884, xlix, p. 49, c. 2 — 32cm.)

The species identified from Stamford, Conn. Its first notice as a pest in conservatories in 1874, and its subsequent distribution; its life-history, as given by Prof. Riley, in the *Rept. Commis. Agricul.* for 1878; remedies for it, and reference to publications upon it.

[See *Second Report on the Insects of N. Y.*, 1885, pp. 142-144.]

The Lunated Long-Sting—Thalessa lunator (Fabr.). (Country Gentleman, for April 17, 1884, xlix, p. 331, c. 3-4 — 52 cm.)

Captured in Augusta, Ga., while ovipositing April first; identified, a figure given, and method of oviposition stated; the insect upon the larva of which it is parasitic, *Tremex columba*, is also shown. A note from Prof. Riley is added, which gives the statement that the parasite feeds on the Tremex larva while attached to its exterior.

[Extended in the *Fourth Report on the Insects of N. Y.*, 1888, pp. 35-42.]

An Insect Attack on a Julus. (The Canadian Entomologist, for April, 1884, xvi, p. 80 — 7 cm.)

Communicating an observation of a swarm of minute insects surrounding, darting upon, and seriously annoying a Julus. Could they have been Ichneumon flies?

Insect Injury to Grapevines. (Country Gentleman, for May 8, 1884, xlix, p. 397, c. 1 — 25 cm.)

Some pieces of grapevines, bearing pinhole-like punctures, from Hopkinsville, Ky., are recognized as having been punctured for oviposition,

by *Œcanthus latipennis* — one of the flower crickets, closely allied to *Œ. niveus*. The punctures and method of oviposition are described, and reference made to figures in Fifth Missouri Report on Insects, page 119. The punctures are not injurious to the vine, but the crickets may possibly cut the stems of the grapes.

Squash Borers. (Country Gentleman, for May 8, 1884, xlix, p. 397, c. 2 — 6 cm.)

Injuries to squash vines, noticed in the Country Gentleman of April twenty-fourth, and there ascribed by the editor to the striped cucumber beetle, *Diabrotica vittata* (Fabr.), are recognized as caused by the squash-vine borer, *Melittia cucurbitæ* (Harris).

The Punctured Clover-Leaf Weevil. (Country Gentleman, for May 29, 1884, xlix, p. 457, c. 2–3 — 56 cm.)

Larvæ submitted from East Avon, Livingston county, N. Y., prove to be the mature forms of *Phytonomus punctatus* (Fabr.). Its present known distribution is given, the transformations, description of its cocoon, and reference to writings upon it. Prompt resort to effective remedies are urged, of which are thorough plowing, and rolling the clover after twilight, at which time the larvæ are feeding.

[The same in the *Ontario County Times*, extra, of May 29, 1884.]

A New Clover Pest — Its ravages in the southern portion of Canandaigua. (Ontario County Times, extra, May 29, 1884 — 30 cm.; Ontario County Times of June 4, 1884, p. 3, c. 4–5 — 85 cm.)

Examples of the larvæ sent by the editor are identified as *Phytonomus punctatus*. To resist the attack plowing is recommended, rolling not being as useful now after the insect has entered the ground for pupation. Reference is made to the notice of the insect in the *Country Gentleman* of May twenty-ninth, and its republication suggested to the editor.

A Corn Cut-worm. (Bulletin No. lxxxvi, of the New York Agricultural Experiment Station, Geneva, May 31, 1884 — 32 cm.)

In reply to an inquiry from Batavia, N. Y., of a cut-worm cutting off corn at the surface of the ground, the different habits of cut-worms are referred to, and recommendation is made of poisoning them by sprinkling London purple over the plants. Another method, which has proved quite effective, is to employ boys to dig them from the hills; mention of a crop saved by this means.

The White Grub of the May-beetle — Lachnosterna fusca. Read before the New York State Agricultural Society at the annual meeting January 16, 1884. (Forty-third Annual Report of the New York State Agricultural Society, for the year 1883, [June fifth], 1884, pp. 20–87, 5 figures.)

Gives an epitome of what is known of this serious pest, and indicates what is needed to complete its life-history. It is treated of under the following heads: The beetle; the white grub; the egg; injurious

character of the insect; injuries from the grub; injuries of the beetle; life-history; distribution; its enemies; preventives and remedies; study of the insect desired.

The Squash-Vine Borer — I. Melittia Cucurbitæ. (Country Gentleman, for June 5, 1884, xlix, p. 477, c. 2–4 — 50 cm.)

Gives, in reply to inquiries made from Coxsackie, N. Y., descriptions of the caterpillar and moth of the above-named insect, and remarks upon the family of *Ægeriadœ*, to which it belongs.

The Squash-Vine Borer —II. (Country Gentleman, for June 12, 1884, xlix, p. 497, c. 2–3 — 40 cm.)

The life-history, so far as known, and habits of the insect are given. Its injuries appear to be increasing with the increase of cultivation of the Hubbard squash. Its abundance at times is shown in the fact that 142 larvæ have been cut from a single vine.

The Squash-Vine Borer —III. (Country Gentleman, for June 19, 1884, xlix, p. 517, c. 1–3 — 74 cm.)

Treats of remedies and preventives, viz: Autumn plowing and harrowing, gas-lime, kerosene, strong-smelling substances as counter-odorants (especially bisulphide of carbon), covering the plants with netting, cutting out the larvæ, rooting the plants at the joints, guano, and London purple, and saltpetre. Additional observations are asked for upon points mentioned.

[The above notices embodied in the *Second Report on the Insects of N. Y.*, 1885, pp. 55–68.]

The Bacon Beetle — Dermestes Lardarius. (Country Gentleman, for June 26, 1884, xlix, p. 537, c. 2 — 25 cm.)

The beetle and larva are described, their food stated, allied species referred to, and inclosing bacon, etc., in whitewashed paper or cloth bags recommended as the best protective from attack. No method is known of preventing attack on salted meats if exposed to the insect.

The Maple-Tree Scale-Insect. (Country Gentleman, for July 3, 1884, xlix, p. 556–7, c 4–1 — 20 cm.)

Identifying *Lecanium innumerabilis* (Rathvon), from Phœnix, N. Y., June 6, describing the scales as at present with the eggs beneath them, and later, when the eggs are extruded, enveloped in waxy fibres. The active larval stage the best time for killing the insects, with whale-oil soap solution or kerosene and milk emulsion. [Is *Pulvinaria innumerabilis.*]

The Spring Canker-Worm — Anisopteryx vernata (Peck). (Country Gentleman, for July 10, 1884, xlix, p. 577, c. 2–3 — 30 cm.)

In answer to inquiries and examples sent from two localities in Westchester county, N. Y.— identification of the species; remarks upon the importance of arresting its spread in the State, and recommendation of destroying the pupæ in the ground beneath the trees; arresting the

ascent of the female moth by tarring the trunks or by tin bands; jarring the larvæ from the limbs into a straw fire beneath, and spraying the tree with Paris green or London purple in water.

The Buffalo Gnat. (Country Gentleman, for July 10, 1884, xlix, p. 577, c. 3–4 — 52 cm.)

The gnat, of which inquiry is made from Memphis, Tenn., is an undescribed species of *Simulidæ*, few of which family have been studied — even the "black fly" of the Adirondack region bears only a manuscript name. The habits and transformations of the *Simulidæ*, in general, are given, with reference to particular species observed. Various notices of the buffalo-gnat are quoted.

[It has subsequently been named by Professor Riley as *Simulium pecuarum*. See his extended notice of it in *Rept. Comm. Agricul.* for 1888, pp. 492–517, plates vi–ix.]

The Carpet-bug. (Amsterdam, N. Y., Daily Democrat of July 21, 1884, p. 3, c. 3–4 — 68 cm.)

In a letter to the editor in reply to inquiries, are given — What the insect is; habits of the insect; not possible to exterminate it; means of protection; means of destruction; hunting the "bug" urged.

The Elm-tree Beetle. (New York Weekly Tribune, for July 23, 1884, p. 10, c. 4 — 13 cm.)

Referring to a recent statement in the *Tribune* that the elm trees in Flushing, L. I., were being destroyed by this insect, recommendation is made of the method given by Mr. Glover in the Agricultural Report for 1870, of placing frames around the base of the trees, so constructed as to prevent the egress of the larvæ that descend the trunks for pupation and their entrance into the ground by a layer of cement. The northward progress of the insect in New York is stated.

[See pp. 234–242 of this Report.]

The Carpet Beetle — Anthrenus Scrophulariæ Linn. (Country Gentleman, for August 14, 1884, xlix, p. 676–7, c. 4–1 — 48 cm.)

Gives in reply to inquiries from Manchester, Vt., its habits, habitat, injuries, materials eaten, and transformations. Among the best preventives and remedies are mentioned carbolic acid, creosote, gas-tar paper, benzine and kerosene, cyanide of potassium, fumigations of closets with sulphur, and frequent searches for the larvæ.

Insects Mining Beet Leaves. (Country Gentleman, for August 14, 1884, p. 677, c. 2 — 13 cm.)

Leaves sent from Erie, Pa., are infested with larvæ of a species of the *Anthomyiidæ*, probably one of the three species mentioned in the *First Report on the Insects of New York*, 1882, pp. 203–211. Some of the characteristics of these flies are given, with notice of their mining operations in this country.

Peach Root Aphis. (Gardener's Monthly and Horticulturist, Phila., September, 1884, xxvi, pp. 271–2—29 cm.)

A root aphis which is destroying all the seedling peach trees of Mr. Lorin Blodget, at Philadelphia, is believed to be *Myzus persicæ* Sulzer. For destroying it the following are suggested: Hot water, leached ashes and sulphur, bisulphide of carbon and soluble phenyle. As superior to the above, the sulpho-carbonates are recommended, and M. Dumas, of the French Academy, quoted upon their use.

A New Rose Pest — Homoptera Lunata. (Country Gentleman, for September 1, 1884, xlix, p. 737, c. 1–2—25 cm.)

Caterpillars feeding at night on rose buds in a rose-house in Madison, N. J., proved to be *Homoptera lunata*. This food-plant had not been previously recorded. The life-history of the species, as detailed by Prof. French, is given, together with Guenée's description of the caterpillar; also mention of the sexual difference in the moths, and the distribution of the species. Injury from the larvæ in rose-houses best prevented by hand-picking them.

[A revision of the above in the *Fourth Report on the Insects of N. Y.*, 1888, pp. 57–59.]

Jumping Seeds. (Country Gentleman, for September 11, 1884, xlix, p. 757, c. 1–2—40 cm.)

The seed-vessels described; said to be a species of *Euphorbia*. The contained insect (a lepidopter) causing the motion, was described and named as *Carpocapsa saltitans*, by Prof. Westwood, in 1858—later by M. Lucas as *C. Deshaisiana*. The interesting generic relation of the insect is referred to, its leaps described, their cause explained, and period of emergence of the moth stated. Three other kinds of jumping seeds are known. Reference to further information.

[Extended, in *Fourth Report on the Insects of N. Y.*, 1888, pp. 151–154.]

The White Grub — Lachnosterna fusca. (Country Gentleman, for September 11, 1884, xlix, p. 757, c. 2–3—22 cm.)

In reply to inquiries from West Stockbridge, Mass., of remedies, etc., reference is made to a paper upon the insect giving about all that is known of it published in the *Forty-third Annual Report of the New York State Agricultural Society*, for 1883. The starvation remedy, as there given and believed to be effectual, is quoted.

An Insect Attack New to the State — Isosoma tritici, on wheat, in Geneva. Bulletin 100, New York Agricultural Experiment Station, Geneva, N. Y., October 4, 1884—86 cm.)

First noticed in Illinois in 1880; its difference from *Isosoma hordei;* location in the upper internodes of the straw; the larvæ more abundant in the straw examined than elsewhere seen; the wheat greatly shriveled; life-history of the insect; its description; two parasites infest it; remedies found in burning the stubble and straw; preventive in rotation of crops.

[Is *Isosoma hordei* (Harris); see *Fourth Report on the Insects of N. Y.*, 1888, pp. 27–35.]

A Stinging Bug — Melanolestes Picipes (H. S.). (Country Gentleman, for October 23, 1884, xlix, p. 877, c. 2–3 — 40 cm.)

An insect reported as inflicting a painful sting upon a lady in Natchez, Miss., is *Melanolestes picipes*, or the "Black Corsair." It is distributed over the United States, and has been previously noticed for the serious wounds it inflicts. Other Hemiptera of the *Reduviidæ* having similar stinging habits, are the *Conorhinus sanguisuga* LeConte, *Melanolestes abdominalis* (H.-S.), *Reduvius personatus* (Linn.), and *Prionotus cristatus* (Linn.). The above are briefly noticed in their habits and painful wounds.

[Extended, in the *Fourth Report on the Insects of New York*, 1888, pp. 109–114.]

An Attack on the Apple Worm — A Friend, Not a Foe. (Country Gentleman, for October 30, 1884, xlix, p. 897, c. 2–4 — 52 cm.)

A larva sent from Crozet, Va., as injurious to apples, from eating large holes into their sides and causing rot, proves to be *Chauliognathus marginatus* (Fabr.). It is not injurious, but enters apples through holes already made, to feed upon the apple-worm — the larva of *Carpocapsa pomonella*. The larva and beetle are described, the latter by comparison with *Ch. Pennsylvanicus*. The holes in quinces, thought to have been made by the same larva, are probably those of the quince curculio, *Conotrachelus cratægi*, in leaving the fruit.

[Extended, in the *Fourth Report on the Insects of New York*, 1888, pp. 84–88.]

Clover Insects. (Transactions of the N. Y. State Agricultural Society, xxxiii, 1877–1882, [October], 1884, pp. 206–207.)

In the republication of the paper on "The Insects of the Clover Plant," from the annual report of the society for the year 1880, a list of the names with reference to authorities of twenty-four species is given, as an addition to the forty-six previously recorded, making the number now known seventy. Mention is made of the list of apple insects (additions in MS.) being extended to one hundred and eighty.

The White Grub. (The New England Homestead, for November 8, 1884, xviii, p. 393, c. 1–3 — 80 cm.)

Treats of the insect under the following heads: The grub; the beetle; its distribution; its food-plants; injuries by the beetle; life-history; its enemies; preventives and remedies. Under the latter head salt is recommended as an experiment, while starvation is pronounced infallible.

Report of the State Entomologist to the Regents of the University of the State of New York, for the year 1883. (Thirty-seventh Annual Report on the New York State Museum of Natural History, by the Regents of the University of the State of New York, [November], 1884, pp. 45–60.)

Reports upon the collections made during the year and other work of the entomologist. Among insects of special interest collected are some

Trypetidæ, *Grapta Faunus*, *G. j-album*, *Feniseca Tarquinius*, and *Agrilus torpidus*; remarks upon *Agrotis clandestina* and *Simulium molestum*; notice of the operations of *Orgyia leucostigma* in girdling elm twigs, and causing them to drop; the English sparrow promoting insect injury; an extended notice of the appearance of the chinch-bug, *Blissus leucopterus*, in northern New York, with recommendations made, and distributed in a circular, for the arrest of its ravages.

The Apple-leaf Bucculatrix. (The Husbandman, Elmira, N. Y., for December 3, 1884, xi, No. 537, p. 1, c. 5 — 31 cm.)

Apple twigs received from Malcolm, Seneca county, N. Y., are covered with the cocoons of *Bucculatrix pomifoliella*. The cocoon is described and life-history of the species given. The remedies mentioned are spraying, or scouring with a stiff brush the infested branches with a kerosene and soap emulsion, of which the formula is given, for killing the insect within the cocoon; Paris green in water for poisoning the caterpillars, and jarring the caterpillars from the trees and burning them in the months of July and September.

[Extended, in the present Report, pp. 260–262.]

On some Rio Grande Lepidoptera. (Papilio, iv, Nos. 7–8, September–October, 1884, pp. 135–147.) [Published February, 1885.]

Gives an annotated list of collections made by Messrs. Sennett and Webster, in 1877 and 1878, viz.: In Rhopalocera, fifty-two species (*Krieogonia Lanice* and *Apatura Cocles*, being new species); in Sphingidæ, four species (*Sphinx insolita* n. sp.); in Ægeriadæ, two species; in Bombycidæ, three species (*Ecpantheria Sennettii* n. sp.).

Scale-Insect Attack on Ivy. (Country Gentleman, for February 26, 1885, l, p. 169, c. 2 — 22 cm.)

Ivy leaves (*Hedera helix*) received from Watervliet, N. Y., and infested on both surfaces and the stem also by *Aspidiotus nerii* Bouché — a scale-insect which infests the cherry, plum, currant, maple, oleander, etc., throughout most of the United States. Remedies recommended under different conditions are scraping, a soap solution, and a soap and kerosene emulsion made in accordance with the formula given.

[Printed, also, in this Report, see pp. 278, 279.]

The Owl Beetle — Alaus Oculatus. (Country Gentleman, for April 9, 1885, l, p. 307, c. 4 — 14 cm.)

The beetle received alive in May, from Aiken, S. C., is described and its habits given. Proves upon later examination to be *Alaus myops* (Fabr.).

Remedies for the White Grub. (The New England Homestead, for May 16, 1885, xix, p. 205, c. 2 — 28 cm.)

The remedies usually recommended for the beetle, insufficient; the grubs may be destroyed by starvation; crops of buckwheat and mustard repel the grubs; how and when salt may be used with benefit.

Cut-worms. Read before the New York State Agricultural Society, at the Annual Meeting, January 21, 1885. (Forty-fourth Annual Report of the New York State Agricultural Society, for the year 1884, [May], 1885, pp. 56–80, figs. 1–20.) (Separate, with cover and half-title [June, 1885], pp. 25, figs. 20.)

The subject is treated of under the following heads: What are Cut-worms? — Their Appearance — Their Habits — Habits of the Moths — Natural History — Conditions Favorable to Cut-worms — Their Food-plants — Abundance of Cut-worms — Literature of the Cut-worms — List of Species — Natural Enemies — Parasites — Preventives and Remedies— Two Preventives Specially Commended — Conclusion.

A Potato-bug Parasite. (The New England Homestead, for June 6, 1885, xix, p. 237, c. 2 — 34 cm.)

A mite infesting and killing Colorado potato-beetles received from Middlesex county, Mass., is identified as *Uropoda Americana* Riley. Description is given of it, its peculiar connecting filament remarked upon, habits of the family of *Gamasidæ* to which it belongs, noticed, together with the importance of the attack, and recommendation of distribution of the serviceable parasite.

[Printed, also, in this Report, see pp. 289-291.]

The Visitation of Locusts. (The Argus [Albany], June 7, 1885, p. 4, c. 5 — 33 cm.)

The announced co-appearance of the seventeen-year locusts and the thirteen-year locusts will not occur in New York; why "locust" is a misnomer; not 221 years, as stated, since the two forms of Cicadas co-appeared, but only thirty years, also thirty-nine years ago; no ground for alarm, as the Cicada harms fruit trees only, and those usually not seriously; notice of the brood of seventeen-year Cicadas to appear about the present time in New York, at Brooklyn and Rochester.

The Pear-Blight Beetle. (Country Gentleman, for June 18, 1885, l, p. 517, c. 2, 3 — 46 cm.)

Xyleborus pyri (Peck), infesting the trunks of young apple trees and killing them, at Annapolis, Md., is identified; description of the beetle; origin of its common name; its two forms of attack; the burrows in the limbs and in the trunk described; the latter ascribed to a second brood but are probably made by the mature insect for food and shelter; remedy for the limb attack, cutting off and burning with the insect; for the trunk attack, not yet known.

The Canker Worm. (Country Gentleman, for June 18, 1885, l, p. 519, c. 2, 3 — 20 cm.)

Spread of the Canker-worm, *Anisopteryx vernata* (Peck) in the State of New York; notice of its presence in large numbers at Loudonville, Albany county; the attack is controllable at the outset, and should not be allowed to extend. The preventives and remedies are, bands, etc., to

prevent the ascent of the wingless female, spraying with Paris green water to kill the larvæ, and working the ground beneath the trees to crush the pupæ.

[Printed in present Report, pp. 258, 259.]

Insect Eggs on Strawberries. (Country Gentleman, for June 25, 1885, l, p. 537, c. 3 — 21 cm.)

The eggs do not indicate an attack that need impair our enjoyment of the fruit. Their presence is unusual and probably accidental. They are the eggs of some hemipterous insect, belonging probably to one of the larger plant-bugs. Description is given of them. The nauseous taste imparted to raspberries by the presence of a small bug, known as *Corimelæna pulicaria*, is referred to, and the insect described. This same insect attacks the blossoms and the stems of strawberries.

Plant-lice, Elm-beetles, etc. (New England Homestead, for July 4, 1885, xix, p. 269, c. 1–2 — 15 cm.)

Identification of *Schizoneura Americana* as injuring leaves of elms at West Stockbridge. The insect reported as stripping the leaves of the elms, is probably the elm-leaf beetle, *Galeruca xanthomelæna*, although not known before to extend so far into Massachusetts. May-flies perhaps mistaken for mosquitoes.

The Apple Tree Bark-louse. (New England Homestead, for July 4, 1885, xix, p. 269, c. 4 – 5 — 20 cm.)

Scales on bark of an apple tree sent are those of *Mytilaspsis pomorum* of Bouché (*M. pomicorticis* Riley). Directions for destroying the insect, by scraping the scales and by spraying kerosene emulsion.

The Cut-Worm and Onion Maggot. (Country Gentleman, for July 9, 1885, l, p. 574 – 5, c. 4, 1 — 20 cm).

For the arrest of cut-worm ravages reported from Globe Village, Mass., the inquirer is referred to remedies given in the paper published in the 44th Rept. N. Y. St. Agricul. Society. For controlling *Anthomyia brassicæ* and *Phorbia ceparum*, the remedies are removing the plants with the soil containing the larvæ, and killing the pupæ with gas-lime or plowing and harrowing repeatedly. Preventives are, strong-smelling substances, and not planting in infested ground.

Peach and Cherry Borers. (Country Gentleman, for July 9, 1885, l, p. 575, c. 1 — 18 cm.)

Peach trees in Annapolis infested by *Phlœotribus liminaris*. It attacks the elm also. The cherry trees are probably infested by *Scolytus rugulosus* Ratz., recently introduced from Europe; see an interesting article upon this species in the Canadian Entomologist for September, 1884. The injuries of *P. liminaris* seem to be rapidly increasing in localities in the State of New York.

The Fig-Eater — Allorhina Nitida. (Country Gentleman, for July 9, 1885, l, p. 575, c. 2–3 — 15 cm.)

The species identified from Madison, N. J., and briefly described; its fondness for juicy fruits; is not known to occur in New York; the larva

is one of the white grubs, and is quite injurious to the roots of grass; its abundance in Washington; the beetle is a pollen feeder and sometimes occurs in great numbers, as in an instance cited. The "trim flower-chafer" might be a better common name for it.

The Roundheaded Apple-tree Borer — Saperda Candida Fabr. (Country Gentleman, for July 16, 1885, l, pp. 590–1, c. 4, 1—33 cm.)

Borers in hawthorn [in Westchester Co., N. Y.], are probably the *Saperda candida;* its burrows and method of destroying the grubs with a strip of flexible steel; recommendation by Dr. Fitch of cutting out the grub; discovering the location and crushing the egg; killing the eggs by application of lye; benefit of mounding about the tree; washing with soap, and soap placed in the forks of the trees for preventives; principal publications upon the insect.

Entomological. [Answers to inquiries.] (Country Gentleman, for July 16, 1885, l, p. 592, c. 2–3 — 20 cm.)

Paris green recommended for killing the potato-beetle infesting egg-plants; road-dust may prevent their attack. For the injuries of the rose-bug, at Waddington, N. Y., to apples and cherries, beating them from the trees recommended; to the former, Paris green might be applied. The abundance of this insect upon fruit trees at times, cited.

The Cause of Black-Knot. (Country Gentleman, for July 23, 1885, l, p. 607 c. 1–2 — 26 cm.)

It is not, as is popularly believed, of insect origin, but is produced by a fungus originally named *Sphæria morbosa*, but recently transferred to the genus *Plowrightia*. There are not "three distinct species," but the same one attacks *Prunus domestica*, *P. Americana*, *P. cerasus*, *P. Virginiana*, *P. Pennsylvanica* and *P. serotina* — two plum trees and four cherry trees. Six species of insects have been bred from the black-knot. The remedy is to cut off and destroy attacked twigs and branches early in July.

[Revised, and printed in this Report, see pp. 280, 281.]

The Cucumber Moth. (Country Gentleman, for July 23, 1885, l, p. 607, c. 2, 3 — 28 cm.)

The borer attacking a melon patch in Carp, Tenn., is, from the description sent, probably the larva of *Phakellura nitidalis* (Cramer), popularly known as the "pickle-worm." In New York and the Eastern States the squash-vine borer *Melittia cucurbitæ* takes its place. The appearance and the habits of the pickle-worm are described. The moth is also described. For remedies, destroy the bored melons, sprinkle with London purple or Paris green water while the moth is ovipositing Figures of the insects are referred to. The borer may possibly be *P. hyalinatalis*, of which the habits are different.

Apple Insects and the Rhinoceros-beetle. (Country Gentleman, for July 30, 1885, l, p. 623, c. 2–3 — 25 cm.)

Of apple insects sent from Coffee, Va., one is *Orgyia leucostigma*, and the other had spun up in a cocoon [subsequently emerged and proved to be *Acronycta* sp.]. The information sent of the *Dynastes Tityus*, that the beetle comes from the ground among the ash trees where its larva had probably been feeding on living vegetable matter, is a new and interesting fact. The record of the manner in which the beetles eat the bark of the ash is also interesting, as also the mention of their being very destructive to tobacco plants, killing all that they attack. [See page 230 of this Report.]

Another Potato Pest. (New England Homestead, for August 8, 1885, xix, No. 32, p. 309, c. 3.)

Macrobasis unicolor (Kirby), one of the blister-beetles, identified as the insect injurious to the foliage of potatoes, in Furnace, Mass. Beating the insects into a basin of water and kerosene, or if very abundant, sprinkling with Paris green or London purple in water, is recommended.

Rœstelia aurantiaca. (Country Gentleman, for August 13, 1885, l, p. 661, c. 3–4 — 10 cm.)

Determination of the above fungus occurring on quinces received from Charlton, Mass. It has usually been found associated with insect attack, as in this instance, where the fruit has been burrowed by probably the apple-worm of the codling-moth.

The False Chinch Bug. (Country Gentleman, for August 13, 1885, l, p. 661, c. 4 — 26 cm.)

Insect described (but no examples sent) and reported as injurious to radishes, turnips, horseradish, strawberries, and raspberries, in Boulder, Col., are, without much doubt, the *Nysius angustatus* of Uhler. It had not previously been known to injure ripe strawberries, but had, according to observations of Professor Forbes, been quite injurious to the foliage of strawberries in Illinois. Kerosene emulsion or pyrethrum could be used to destroy the bug when upon strawberries, until the fruit is about half grown.

The Bag-Worm — Thyridopteryx Ephemeræformis. (Country Gentleman, for October 1, 1885, l, p. 801, c. 4 — 20 cm.)

To an interesting account of the habits of a "worm" destroying arbor vitæ hedges in Franklin Park, N. J., and request for information in regard to it, reply is made of its name as above, and the best methods for checking its injuries, viz., application of Paris green, and hand-picking, and destroying the cases of the female moth. A figure illustrating the several stages of the insect is also given.

The Red Spider — Tetranychus Telarius (Linn.). (Country Gentleman, for October 8, 1885, l, p. 821, c. 3–4 — 38 cm.)

Mites infesting various garden plants, at Utica, N. Y., are this species which, standing at the head of the Acarina, approaches near to the

spiders. It spins webs on the under side of the leaves for shelter, while sucking the juices of the various plants upon which it occurs; those upon which it was noticed at Utica are mentioned. It has this summer been discovered in an injurious attack on a quince orchard near Geneva, N. Y. Kerosene emulsion, soap solution with sulphur mixed, and quassia infusion may be used for killing it. It was the cause of the yellow discoloring of the leaves of a nasturtium in the garden of the writer.

[Printed, also, in this Report, see pp. 287–289.]

The Thirteen-year Cicada. (The Argus [Albany], for October 11, 1885, p. 4 — 32 cm.)

A paper read before the Albany Institute, containing remarks upon the exceptional long life-period of the *Cicada septendecim;* the number of broods occurring in the United States and in the State of New York; notice of a thirteen-year brood, and that its occurrence only in the Southern States may be the result of hastened development through higher temperature; Professor Riley's experiments in transferring the two forms from one region to another; and record of the planting of the eggs of a thirteen-year brood at Kenwood, near Albany.

[Printed, also, in this Report, see pp. 276–278.]

The Elm Leaf Beetle. (Country Gentleman, for October 15, 1885, l, p. 841, c. 3–4 — 23 cm.)

The inquirer, from Bordentown, N. J., of methods for killing the insects destroying the foliage of his elm trees, is referred to a notice of the insect, *Galeruca xanthomelæna*, in the *Country Gentleman* for October 12, 1882 (p. 805), and to Bulletin No. 6 of the Division of Entomology of the U. S. Agricultural Department. Of the arsenical insecticides recommended, London purple is preferred, in the proportion of one-half pound to three quarts of flour and a barrel (forty gallons) of water. Directions for mixing are given, and the advantages of its use stated.

The Clubbed Tortoise-beetle. (Country Gentleman, for October 15, 1885, l, p. 841, c. 4 — 12 cm.)

Remarks upon *Coptocycla clavata* (Fabr.), its appearance, habits and food-plants. Reference to its occurrence on the potato, tomato, and egg-plant.

A Leaf-mining Insect. (Home Farm [Augusta, Me.], for October 15, 1885, p. 1, c. 6 — 20 cm.)

A leaf-miner reported in Maine, and in the vicinity of Boston, Mass., is identified as one of the Anthomyians, and probably *Chortophila betarum* Lintn., which is known to have distribution in New York and Connecticut. The approved methods for meeting its attack, are prevention of egg-deposit by the use of counterodorants, and burning the infested leaves.

The Death-Watch, Clothilla Pulsatoria. (Country Gentleman, for October 22, 1885, l, p. 861, c. 3-4 — 21 cm.)

A supposed parasite found in cow-stalls in Warren, O., is this insect, a figure of which is given. The habits of the *Psocidæ* are briefly stated, and the reason why this species has received the name of the "death-watch." It has previously occurred in immense numbers in barn refuse after threshings, and in straw-packings in a wine cellar.

[See *Second Report on the Insects of N. Y.*, pp. 201, 202.]

Eggs of a Katydid. (Country Gentleman, for October 29, 1885, l, p. 881, c. 4 — 23 cm.)

Eggs sent from Lexington, Va., arranged in two rows upon the opposite sides of the back fold of a copy of the *Country Gentleman*, are those of *Microcentrus retinervis*, an insect common in some of the warmer States of the Union, and classed by some writers with the katydids, although strictly, the name of katydid would belong only to *Platyphyllum concavum*. The eggs are described, and reference made for the illustration and life-history of the species to the 6th Missouri Report.

[The name should have been given as *Microcentrum retinervum.*]

A New Insect Foe to the Cut-worm. (New England Homestead, for October 31, 1885, xix, No. 44, p. 405, c. 3-4 — 19 cm.)

A correspondent from Winsted, Ct., sends for information a fly hatched from some cabbage cut-worms kept in confinement. The fly is a species of *Gonia* belonging to the *Tachinidæ*, the parasitic habits of which are given. Caterpillars bearing upon their body the white eggs or the egg-shell of these flies should not be destroyed, but permitted to furnish food for the beneficial larvæ that are feeding within them. The cabbage cut-worm was probably *Mamestra trifolii* (Rott.).

Saw Fly on Fruit Trees. (Country Gentleman, for November 12, 1885, l, p. 921, c. 3-4 — 25 cm.)

In answer to an inquiry from Edinburgh, Scotland, of some small, thin, nearly transparent objects nearly half an inch long and looking like a leech, which for several years had nearly destroyed the leaves of plum, pear, and cherry trees, reply is made that it is the larva of some species of saw-fly, and probably of *Eriocampa adumbrata*. Its ravages may be prevented by means of powdered hellebore, to be obtained pure, and applied to the foliage by the hand or by a bellows. Its efficacy is illustrated by an account of its use in the Hammond Nurseries at Geneva, N. Y. Directions are given for using the hellebore mixed with water, if more convenient in this form.

(B.)

CONTRIBUTIONS TO THE DEPARTMENT.

The following are the contributions that have been made to the Department during the year (1888):

In Hymenoptera.

Cocoons of *Nematus Erichsonii* Hartig, and the imago, May 8th. From Rev. H. W. Swinnerton, Cherry Valley, N. Y.

Galls of *Neuroterus verrucarum* (O. S.), on *Quercus* sp.? From J. Carter Brown, Kingston, R. I.

Apanteles congregatus (Say) cocoons on ?*Darapsa Myron*. From Mrs. K. M. Busick, Wabash, Ind

In Lepidoptera.

Larvæ of *Thyreus Abbotii* Swainson, July 26th. From A. J. Richmond, Canajoharie, N. Y. The same, from Dr. R. H. Sabin, Troy, N. Y. The same (spotted form), from Horace B. Derby, Albany, N. Y., July 6th. The same (striated form), from S. C. Bradt, Albany, N. Y., July 8th.

Datana ministra (Drury) larvæ from apple tree, Sept. 4th. From M. T. Richardson, New York city.

Œdemasia concinna (Sm.-Abb.) larvæ from apple tree early in September. From John C. Shaw, Brooklyn, N. Y.

Callosamia Promethea (Drury) cocoons on wild cherry. From E. J. Reddy, Bayville, N. Y. The same, on plum, from Mrs. E. W. K. Lasell, Orange, N. J. The same, from Berthold Fernow, Albany, N. Y.

The regal walnut-moth, *Citheronia regalis* (Fabr.), taken at the State Camp, Peekskill, N. Y., August 5th. From Dr. C. W. Crispell, Kingston, N. Y.

Larva of *Eacles imperialis* (Drury) with puparia of a Tachinid-fly, Sept. 10th. From S. C. Bradt, Albany, N. Y.

Clisiocampa Americana Harris, larvæ and cocoon. From Berthold Fernow, Albany, N. Y.

Larvæ of *Gortyna nitela* Guenée, burrowing in stalks of young corn, June 22. From Rock Hall, Md.

Larvæ of *Cacœcia argyrospila* (Walk.) eating into young pears, June 13th; and of *Coleophora* sp.? eating into the same, June 8th. From P. Barry, Rochester, N. Y.

In Diptera.

"Flax-seeds" (puparia) of the Hessian-fly, *Cecidomyia destructor* Say, in wheat. From Prof. F. M. Webster, LaFayette, Ind.

Galls of *Lasioptera vitis* O. S., June 27th. From H. L. Fisk, Worcester, Mass.

Tipulid larvæ found in association with cocoons of *Nematus Erichsonii*, May 18th. From Rev. H. W. Swinnerton, Cherry Valley, N. Y.

The "cow-fly," *Hœmatobia serrata* Desvd. From Samuel W. Shimer, Mount Holley, N. J.

In Coleoptera.

Dytiscus fasciventris Say. From Joseph Harvey, Albany, Oct. 20th. The same from John D. Collins, Utica, N. Y., Nov. 5th.

Dytiscus Harrisii Kirby, October 24th. From H. G. Settle, Saratoga Springs, N. Y.

The carpet-beetle, *Anthrenus scrophulariæ* Linn., from Crocus, April 27th. From Mrs. Hoagland, Albany, N. Y.

Alaus oculatus (Linn.). From Mrs. E. W. K. Lasell, Orange, N. J.

Anomala lucicola (Fabr.), the light-loving grapevine-beetle, July 13th. From W. W. Sweet, Hightstown, N. J.

Pelidnota punctata (Linn.), *Desmocerus palliatus* (Forst.), and *Saperda candida* Fabr. From C. G. Belknap, Branchport, N. Y.

Oak twigs cut by the oak-tree pruner, *Elaphidion parallelum* Newm. From George T. Lyman, Bellport, N. Y.; also, from Dr. James W. Hall, Sea Cliff, L. I., N. Y.; also, from C. Fred Johnson, Bayport, N. Y.

Monohammus confusor (Kirby). From Berthold Fernow, Albany, N.Y.

A Cerambycid-beetle (four inches in length, species undetermined), from Colon, Central America. From M. B. Harriot, Albany, N. Y.

The elm-leaf beetle, *Galeruca xanthomelæna* (Schr.), May 1st. From D. J. Garth, Scarsdale, N. Y.

Aramigus Fulleri Horn, from a rose-house, June 30th. From W. J. Palmer, Rochester, N. Y.

Plum curculio oviposition in young pears, June 8th. From P. Barry, Rochester, N. Y.; also, the same, in young cherries, June 7th, from George S. Powell, Ghent, N. Y.

The grain-weevil, *Calandra granaria* (Linn.), in wheat. From Abner L. Backus & Sons, Toledo, O.

Young Duchess pear trees (sections) girdled by *Xyleborus pyri* (Peck), and containing the beetle, May 22d. From Norman Pomroy, Lockport, N. Y.; also from E. S. Goff, Geneva, N. Y.

Phlœotribus liminaris (Harris) — the living beetle in bark of peach tree, October 19th. From David Huntington, Somerset, Niagara Co., N. Y.

In Hemiptera.

Lygus pratensis (Linn.) *C. lineolaris* of Beauv., with young pears punctured and gnarled by it. From P. Barry, Rochester, N. Y.

The melon plant-louse, *Aphis cucumeris* Forbes. From T. C. Barker, Lowell, Mass.

The cockscomb elm-gall, *Glyphina ulmicola* (Fitch) on "weeping slippery elm," *Ulmus* sp.? From C. H. Hedges, Charlottesville, Va.

The grapevine bark-louse, *Pulvinaria innumerabilis* (Rathvon), on soft maple. From H. E. Hayes, New York.

The cottony-cushion scale, *Icerya Purchasi* Maskell, on *Acacia* in Lamonda Park, Los Angeles Co., Cal. From A. O. Osborne, Waterville, N. Y.

The scurfy bark-louse, *Chionaspis furfurus* (Fitch), on a pear tree twig. From J. M. Clarke, Albany, N. Y.

In Orthoptera.

Eggs of *Microcentrum retinervum* (Burm.) on currant stem and on *Cercis Japonica.* From Prof. W. S. Robinson, Elizabeth, N. J.; also from S. B. Husted (April 20th), Blauvelt, N. Y.

Eggs of *Œcanthus niveus* Serv. in Concord grapevines. From W. D. Barnes, Middlehope, N. Y. The same, from St. Catherines, Ontario; from E. S. Goff, Agricultural Experiment Station, Geneva, N. Y.

Œcanthus niveus (De Geer) ♂. From Jonas Brooks, Albany, N. Y.; also in both sexes, from Mrs. E. B. Smith, Coeymans, N. Y.

Apple-tree twigs showing oviposition of an *Œcanthus*, not *niveus.* From W. L. Devereaux, Clyde, N. Y.

Gryllotalpa longipennis Scud. From Dr. C. W. Crispell, Kingston, N. Y.

In Neuroptera.

Corydalis cornutus (Linn.), the hellgrammite fly, August 5th. From Dr. C. W. Crispell, Kingston, N. Y.

In Arachnida.

Galls of *Phytoptus quadripes* (Shimer) on leaves of soft maple, June 5th. From E. Dayton Joslin, Lake Grove, Suffolk Co., N. Y.

In Myriapoda.

Julus cœruleocinctus Wood, from beneath a carpet. From Wm. G. Warren, Buffalo, N. Y., and from Mrs. Ira Harris, Loudonville, N. Y. The same, from roots of geraniums, September 27th. From John B. Hoffman, Cape May, N. J.

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PLANT INDEX.

REPORT

OF THE

STATE GEOLOGIST,

FOR THE YEAR 1888.

REPORT.

To the Honorable the Board of Regents of the University of the State of New York:

Gentlemen. — In order to bring to an early completion the contemplated work upon the Palæontology of the State of New York, it has been necessary for the State Geologist, for several years past, to restrict himself almost entirely to the preparation and publication of these volumes. I have heretofore annually reported the condition of the work and the general results of progress. Last year I was able to report the completion of volume VI of Palæontology, giving a synopsis and summary of the genera and species of Corals and Bryozoa described in the volume, the total number of species being 385, which are arranged under seventy-two genera. At the same time I called attention to the unfinished work upon the Bryozoa which had been carried on toward completing the volume before the law was passed restricting the number of pages and plates, which rendered it impossible to include all the material in preparation.

Without going into any further statement regarding the condition of this work I will here repeat my recommendation of last year, hoping it may meet the approval of the board. "The best and most satisfactory disposition of this would be the publication of a supplemental volume of about twenty plates with text of 150 pages, to include a synopsis and classification together with the proper illustrations, and with the descriptions of the new species. This would serve to give a completeness to the work which it now lacks, and which, from the great amount of new material that would be presented in the volume, we should feel it a duty to publish."

Besides the publication of this material as a contribution to science, the illustration of authentic examples of the genera of Bryozoa would make such a volume an important hand-book for students in science.

The Corals and Bryozoa of the Lower Helderberg, and the Bryozoa of the Upper Helderberg and Hamilton groups, which

have been used in illustration of volume VI, remain arranged in drawers, but they are essentially inaccessible to students of the science. I have several times urged the importance of selecting from the very extensive mass of material among the Corals and Bryozoa, a very complete series for arrangement and study in the State Museum, and the disposition of the remainder as duplicates; I have thus far received no authority to do anything in this direction, but I feel confident that such a work would greatly inure to the advantage of the Museum, and would at the same time relieve the overcrowded condition of the storage drawers. We have at the present time scarcely any unoccupied drawer-space remaining for the disposition of current collections.

At the present time the collections remain in the same condition as when first arranged in drawers in the State Hall in 1886, and there seems no immediate prospect of their being made available, either for systematic arrangement and publication or for the distribution of the large number of duplicates which might be made available for school and college collections or for exchange.

In my report of last year I was able to communicate a summary of the contents of volume VII, so far as to give a list of the families and genera which were to be described in the volume. Also a list of the plates and their contents, indicating those already lithographed and those yet remaining to be done. Since that time the volume has been published in May, 1888. It includes descriptions and figures of the Crustacea of the Upper Helderberg, Hamilton and Chemung groups; together with a supplement to volume V, part ii, containing plates cxiv to cxxix. These supplementary plates contain illustrations of the Pteropoda and Annelida of the Silurian and Devonian strata which are illustrated on plates cxiv to cxvi and cxvi*a*, while the plates cxvii to cxxix are devoted to the further illustration of the genera Orthoceras, Gomphoceras, Cyrtoceras, Nautilus and Goniatites.

For the better appreciation of the character and contents of this volume, I introduce in this place some pages from the introduction, embracing the history, classification and chronological distribution of the genera and species together with a synoptical table of the genera and species of Devonian Crustacea described in the volume. This is supplemented by a list of the type specimens which are in possession of the State Museum of Natural History.

The Crustacea described in this volume are, primarily, the species from the Devonian formations of the State of New York, and incidentally such species from other horizons as it seemed important to introduce into the work, either for purposes of comparison or for the furtherance of our knowledge in other respects. Since comparatively few species of the North American Devonian Crustacea have been found to occur exclusively outside the limits of the State of New York, these extra-limital species, for the sake of completeness, have been brought within the scope of the work. The volume may, therefore, for the present, be regarded as a monograph of these Devonian Crustacea (not including the Ostracoda).

In the ensuing discussions of the species the order followed is taxonomic, although no single system of classification has been rigidly adhered to. The chronological arrangement of the species is therefore subordinated to the zoölogical order of the genera and families.

I. Historical.

The first published notice of the North American Devonian Trilobites was given by Alexandre Brongniart ("Crustacés Fossiles," 1822), who referred to his species *Calymene macrophtalma*, two American specimens, one of which is probably referable to the species *Phacops bufo* or *P. rana*, Green, and the other, a plaster cast of a specimen which subsequently served as the type of *Calymene* [*Dalmanites*] *anchiops*, Green. In 1824, Dr. James E. De Kay (Annals of the Lyceum of Natural History, New York), recognized the *Calymene macrophthalma* (=*Phacops rana*), "on the Helderberg mountain, near Albany, and at Coshung Creek, near Seneca Lake." In 1832, Professor Amos Eaton (Geological Text-book), described the species *Nuttainia sparsa* (=*Homalonotus DeKayi*, Green), and *Asaphus* (=*Dalmanites*) *selenurus*. This work was followed, in the same year, by "A Monograph of the Trilobites of North America, with Colored Models of the Species," by Jacob Green, M. D., accompanied by a Supplement in 1835. This Monograph included several of the best known and most characteristic of the Devonian species, namely:

Calymene platys.
Dipleura (*Homalonotus*) *Dekayi.*
Calymene (=*Phacops*) *bufo.*
C. bufo. var. *rana*=*Phacops rana.*
Asaphus (=*Dalmanites*) *pleuroptyx.*
A. (=*D.*) *myrmecophorus.*
Calymene (=*D.*) *anchiops.*
Calymene ? Odontocephala=*D. selenurus.*

In the same year (1832) Prof. Amos Eaton described the species *Nuttainia sparsa* (=*Homalonotus Dekayi*, Green), and *Asaphus* (=*Dalmanites*) *selenurus* (Geological Text-book). In the Annual Reports of the Palæontological Department of the New York State Geological Survey, Mr. T. A. Conrad, in 1840 and 1841, described the species *Odontocephalus selenurus* (Eaton sp.) and *Asaphus* (=*Dalmanites*) *aspectans*. From this date onward to the year 1861, brief notices of American Devonian Trilobites were published by various writers, viz.:

Burmeister,	Emmons,	Owen,	Vanuxem.
Castelnau,	Hall,	Shumard,	

In 1861, Professor James Hall published (Descriptions of New Species of Fossils from the Upper Helderberg, Hamilton and Chemung groups; in advance sheets of the Fifteenth Annual Report of the New York State Cabinet of Natural History) a brief revision of the previously described Devonian Trilobites from the State of New York, with the addition of several new species. The following species were discussed:

Calymene platys, Green.
Homalomotus Dekayi, Green.
Phacops cristata, Hall.
Phacops bombifrons, Hall (=*Ph. cristata*, partim).
Phacops rana, Green.
Phacops bufo, Green.
Phacops Cacapona, Hall.
Phacops nupera, Hall (1843).
Dalmania (=*Dalmanites*) *concinna*, Hall.
Dalmania Helena, Hall (=*Dalmanites aspectans*, Conrad).
Dalmania (=*Dalmanites*) *myrmecophorus*, Green.
Dalmania (=*Dalmanites*) *emarginata*, Hall.
Dalmania (=*Dalmanites*) *Pleione*, Hall.
Dalmania (=*Dalmanites*) *Boothii*, Green.
Dalmania (=*Dalmanites*) *selenurus*, Eaton.
Dalmania (=*Dalmanites*) *bifida*, Hall.
Dalmania (=*Dalmanites*) *Ægeria*, Hall.
Dalmania (=*Dalmanites*) *coronata*, Hall.
Dalmania (=*Dalmanites*) *anchiops*, Green.
Dalmania (=*Dalmanites*) *anchiops*, var. *armata*, Hall.
Dalmania (=*Dalmanites*) *Calypso*, Hall.
Dalmania (=*Dalmanites*) *Erina*, Hall.
Dalmania (=*Dalmanites*) *macrops*, Hall.
Lichas grandis, Hall.
Lichas armatus, Hall (=*L. Eriopis*, Hall).
Proëtus Conradi, Hall.
Proëtus angustifrons, Hall.
Proëtus Hesione, Hall.
Proëtus crassimarginatus, Hall.
Proëtus clarus, Hall.
Proëtus canaliculatus, Hall.
Proëtus Verneuili, Hall.
Proëtus Haldemani, Hall.
Proëtus macrocephalus, Hall.
Proëtus marginalis, Conrad.
Proëtus Rowii, Green.
Proëtus longicaudus, Hall.
Proëtus occidens, Hall.

These species were, at this date, mostly published without illustration, but figures of them, and a few additional Devonian species, were given in the Illustrations of Devonian Fossils, in 1876.

The following authors have published descriptions or notices of the American Devonian Trilobites, and full reference to their works will be found under the generic and specific synonymies:

Barris,	Conrad,	Meek,	Walcott,
Billings,	Eaton,	Nicholson,	Whitfield,
Brongniart,	Emmons,	Owen,	Williams, H. S.,
Burmeister,	Green,	Shumard,	Williams, S. G.,
Castelnau,	Hall,	Vanuxem,	Worthen.
Clarke,	Kayser,	Vogdes,*	

The other orders of the Crustacea have only more recently attracted the attention of American writers. The XIPHOSURA have been discussed by Williams and Packard; the EURYPTERIDA, by Hall and Claypole; the PHYLLOCARIDA, by Hall, Whitfield, Clarke, Packard, Beecher, Woodward and Jones; the DECAPODA, by Whitfield; the PHYLLOPODA, by Clarke, Packard and Jones; and the CIRRIPEDIA, by Whitfield and Clarke.

II. Classification.

In the discussions of the species, it has not seemed advisable to accord a strict adherence to any given system of classification. The Trilobites, which include the larger and, for the geological student, the most important part of the work, stand first in order of treatment; the other orders of the subclass to which they belong, being considered in the latter portion of the work. In the introductory discussion of the genera the same order is followed.

The classification which has been adopted, with modifications, for the purpose of the work, is the following:

CLASS, CRUSTACEA.

Subclass A: ENTOMOSTRACA.

Order I: CIRRIPEDIA.

Family a: **Lepadidæ.**

Genus 1: Strobilepis.

Genus 2: Turrilepas.

Family b: **Balanidæ.**

Genus 3: Protobalanus.

Order II: PHYLLOPODA.

Family a: **Limnadiadæ.**

Genus 4: Estheria.

Genus 5: Schizodiscus.

Order III: TRILOBITA.

Family a: **Calymenidæ.**

Genus 6: Calymene.

* It is understood that a "Bibliography of the Palæozoic Crustacea," by Lieut. Vogdes is ready for press at the present writing.

Genus 7: Homalonotus.

Family b: **Bronteidæ.**

Genus 8: Bronteus.

Family c: **Phacopidæ.**

Genus 9: Phacops.
Genus 10: Dalmanites.
Subgenus 1: Hausmannia.
Subgenus 2: Coronura.
Subgenus 3: Cryphæus.
Subgenus 4: Odontocephalus.
Subgenus 5: Chasmops.

Family d: **Acidaspidæ.**

Genus 11: Acidaspis.

Family e: **Lichadæ.**

Genus 12: Lichas.
Subgenus 1: Terataspis.
Subgenus 2: Conolichas.
Subgenus 3: Hoplolichas.
Subgenus 4: Arges.
Subgenus 5: Ceratolichas.
Subgenus 6: Dicranogmus.

Family f: **Proetidæ.**

Genus 13: Proëtus.
Genus 14: Phaëthonides.
Genus 15: Cyphaspis.

Subclass B: MEROSTOMATA.

Order IV: XIPHOSURA.

Family a: **Limulidæ.**

Genus 16: Protolimulus.

Order V: EURYPTERIDA.

Family a: **Eurypteridæ.**

Genus 17: Eurypterus.
Genus 18: Stylonurus.

Subclass C: MALACOSTRACA.

Order VI: PHYLLOCARIDA.

Family a: **Ceratiocaridæ.**

Genus 19: Ceratiocaris.
Genus 20: Echinocaris.
Genus 21: Elymocaris.
Genus 22: Tropidocaris.

Family b: **Pinacaridæ.**

Genus 23: Mesothyra.

Family c: **Rhinocaridæ.**

Genus 24: Rhinocaris.

Family d: **Discinocaridæ.**

Genus 25: Spathiocaris.
Genus 26: Dipterocaris.

Order VII: DECAPODA.

Family a: **Carididæ.**

Genus 27: Palæopalæmon.

III. CHRONOLOGICAL DISTRIBUTION.

Oriskany Sandstone.

In the eastern outcrops of this formation but a single Crustacean species is known, the gigantic *Homalonotus major*, from Ulster county. In the western extension of these rocks into the Province of Ontario, are the species *Phacops cristata*, *Dalmanites* (*Hausmannia*) *pleuroptyx* and *Dalmanites* (*Chasmops*) *anchiops*, all of which occur in the overlying Upper Helderberg limestones, a fact which indicates the close alliance of the western Oriskany fauna to the true Devonian.

UPPER HELDERBERG GROUP.

Cauda-galli Grit.

No Crustacea have been found in this formation.

Schoharie Grit.

The rich Crustacean fauna of these rocks is exclusively trilobitic, and consists of eighteen species from the localized development of the formation in eastern New York. These are:

Calymene platys.	*Acidaspis callicera.*
Phacops cristata.	*Lichas (Terataspis) grandis.*
Dalmanites (Hausmannia) concinnus.	*Lichas (Conolichas) hispidus.*
Dalmanites (Coronurus) emarginatus.	*Proëtus Conradi.*
Dalmanites (Corycephalus) regalis.	*Proëtus angustifrons.*
Dalmanites (Chasmops) anchiops.	*Proëtus Hesione.*
Dalmanites (Chasmops) anchiops, var. *armatus.*	*Proëtus crassimarginatus.*
	Proëtus sp.
Dalmanites (Chasmops) anchiops, var. *sobrinus.*	*Phaëthonides arenicolus.*
	Cyphaspis minuscula.

In addition to these are the species *Proëtus curvimarginatus* and *Proëtus latimarginatus*, from the sandstone beds at Pendleton, Indiana, which lie at the base of the Corniferous limestone, and contain a fauna closely allied to that of the Schoharie grit in the State of New York.

Corniferous Limestone.

The greatest numerical development of the Devonian Crustacea, as a whole, is found in this extensive formation. The species are, however, mostly of Trilobites which here attain their specific and individual culmination, all other orders of Crustacea, excepting the CIRRIPEDIA, being unrepresented. The condition of preservation of the fossils is often unsatisfactory, the specimens being generally in a disjointed or fragmentary condition; moreover the character of the matrix is such that it is often a matter of great difficulty to prepare the specimens in a proper manner for study. When the test of the animal has been silicified the matrix is usually in the same condition, and when preserved in the limestone, the substance of the test is usually softer and more friable than the matrix. The transported boulders of chert which are found abundantly in the drift accumulations south of the lines of outcrop of these rocks, and have become decomposed by the gradual removal of the calcic carbonate mixed with the silica, have proved a very fruitful source of instructive specimens. On account of the usually fragmentary condition of the specimens, a few of the species here described may eventually prove to be founded upon different parts of the

same animal. The following fifty-two species constitute the present known Crustacean fauna of this formation:

TRILOBITA.

Calymene platys.
Phacops cristata.
Phacops cristata, var. *pipa.*
[?] *Phacops rana.*
Dalmanites (Hausmannia) pleuroptyx
Dalmanites (Hausmannia) concinnus.
Dalmanites (Hausmannia) concinnus var. *serrula.*
Dalmanites (Hausmannia) phacoptyx
Dalmanites (Coronura) aspectans.
Dalmanites (Coronura) myrmecophorus.
Dalmanites (Cryphæus) comis.
[?] *Dalmanites (Cryphæus) Boothi.*
Dalmanites (Odontocephalus) selenurus.
Dalmanites (Odontocephalus) bifidus.
Dalmanites (Odontocephalus) Ægeria.
Dalmanites (Odontocephalus) coronatus.
Dalmanites (Corycephalus) pygmæus
Dalmanites (Chasmops) anchiops.
Dalmanites (Chasmops) anchiops, var. *armatus.*
Dalmanites (Chasmops) Calypso.
Dalmanites (Chasmops) Erina.
Dalmanites (Chasmops ?) macrops.
Acidaspis callicera.
Acidaspis sp.
Lichas (Terataspis) grandis.
Lichas (Conolichas) hispidus.
Lichas (Conolichas) Eriopis.
Lichas (Hoplolichas) hylæus.
Lichas (Arges) contusus.
Lichas (Ceratolichas) gryps.
Lichas (Ceratolichas) dracon.
Proëtus crassimarginatus.
Proëtus folliceps.
Proëtus clarus.
Proëtus canaliculatus.
Proëtus Verneuili.
Proëtus microgemma.
Proëtus stenopyge.
Proëtus ovifrons.
Proëtus delphinulus.
Proëtus (?) planimarginatus.
Proëtus tumidus.
Phaëthonides arenicolus.
Phaëthonides varicella.
Phaëthonides gemmæus.
Cyphaspis minuscula.
Cyphaspis stephanophora.
Cyphaspis diadema.
Cyphaspis hybrida.

CIRRIPEDIA.

Palæocreusia Devoniaca.
Turrilepas flexuosus.
Turrilepas cancellatus.

Of these species *one* occurs in the Lower Helderberg group, viz.: *Dalmanites (Hausmannia) pleuroptyx;* three in the Oriskany sandstone, viz.: *Phacops cristata, Dalmanites (Hausmannia) pleuroptyx* and *Dalmanites (Chasmops) anchiops;** and *eleven* in the Schoharie grit, viz.:

Calymene platys.
Phacops cristata.
Dalmanites (Hausmannia) concinnus.
Dalmanites (Chasmops) anchiops.
Dalmanites (Chasmops) anchiops, var. *armatus.*
Acidaspis callicera.
Lichas (Terataspis) grandis.
Lichas (Conolichas) hispidus.
Proëtus crassimarginatus.
Phaëthonides arenicolus.
Cyphaspis minuscula.

But a single characteristic species of this fauna ranges upward into the Hamilton beds, viz.: *Phaëthonides gemmæus.*

*The examination of a later collection of fossils of the Oriskany Sandstone from Cayuga, Ontario, shows the occurrence of *Dalmanites (Chasmops) anchiops*, Green, *D. (Hausmannia) pleuroptyx*, Green, *Homalonotus Vanuxemi*, Hall, *H. major*, Whitfield, *Phacops cristata*, Hall, *Proëtus crassimarginatus*, Hall, *Calymene platys*, Green, Fish spine.

Hamilton Group.

Marcellus Shales.

The Trilobites found in these beds all pass upward into the Hamilton shales where they attain a more complete development, These are:

Homalonotus Dekayi.
Phacops rana.
Dalmanites (Cryphœus) Boothi.
Proëtus Haldemani.
Proëtus macrocephalus.

The peculiar character of the sea which deposited these bituminous shales was not favorable to the existence of these animals, and it is only where the deposit becomes calcareous that the trilobitic remains are found. In addition to these occurs the earliest known species of the Devonian Phyllocarida, *Mesothyra (Dithyrocaris?) Veneris,* and the interesting Cirripede, *Protobalanus Hamiltonensis.*

Hamilton Shales.

In the rich fauna of these beds, the Crustacean element is much more varied than at any other Devonian horizon. The Trilobites have become much fewer in number since the close of the Upper Helderberg period, the Crustacea being represented by other orders of this class. The species occurring in the group are as follows:

Homalonotus Dekayi.
Phacops rana.
* *Phacops bufo.*
* *Phacops Cacapona.*
* *Dalmanites (Hausmannia ?) Meeki.*
* *Dalmanites (Cryphœus) Pleione.*
Dalmanites (Cryphœus) Boothi.
Dalmanites (Cryphœus) Boothi, var. *Calliteles.*
* *Dalmanites (Cryphœus) Barrisi.*
* *Acidaspis Romingeri.*
Proëtus Haldemani.
Proëtus macrocephalus.
Proëtus Rowi.
Proëtus jejunus.
* *Proëtus Phocion.*
* *Proëtus Prouti.*
* *Proëtus Nevadæ.*
* *Proëtus occidens.*
* *Proëtus (?) longicaudus.*
Phaëhonides gemmœus.
Phaëhonides (?) denticulatus.
Cyphaspis ornata.
Cyphaspis ornata, var. *baccata.*
Cyphaspis craspedota.

Of this list those bearing a star (*) are from localities outside the State of New York, which may be regarded as of the age of the Hamilton group.

Of the Phyllocarida, are:

Echinocaris punctata.
Elymocaris capsella.
Tropidocaris Hamiltoniæ.
Mesothyra Neptuni.
Mesothyra spumœa.
(Dithyrocaris) Belli.
Rhinocaris columbina.
Rhinocaris scaphoptera.

Of the Phyllopoda, the species:

Estheria pulex.
Schizodiscus capsa.

Of the Cirripedia:

Strobilepis spinigera.
Turrilepas Devonicus.
Turrilepas squama.
Turrilepas nitidulus.
Turrilepas foliatus.
Turrilepas tener.

Of these forty species, twenty-nine occur within the limits of this State.

Tully Limestone.

Trilobite remains only have been found in this formation, and these are, with one exception, the more common species of the underlying shales.

Bronteus Tullius.
Phacops rana.
Dalmanites (Cryphæus) Boothi.
Dalmanites (Cryphæus) Boothi, var. *Calliteles.*
Proëtus Rowi.
Proëtus macrocephalus.

Genesee Shales.

These bituminous beds have produced but a single Crustacean, *Ceratiocaris longicauda.*

Portage Group.

Under this designation, as used in this work, are included all the shales and sandstones lying between the Genesee slate below and the lowest sandstones bearing a typical Chemung fauna. These beds and their equivalents in other States have produced no Trilobites, their Crustacean fossils being mostly Phyllocarida. They are:

Stylonurus ? (Echinocaris ??) Wrightianus.
Ceratiocaris Beecheri.
Ceratiocaris simplex.
Echinocaris Whitfieldi.
Echinocaris sublævis.
Echinocaris pustulosa.
Echinocaris multinodosa.
Mesothyra Oceani.
Spathiocaris Emersoni.
Dipterocaris pennæ-Dædali.
Dipterocaris pes-cervæ.
Palæopalæmon Newberryi.

Chemung Group.

In the sandstones of this period the Trilobites are represented by two species, *Phacops nupera** and *Cyphaspis lævis;* the Xiphosura, by the species *Protolimulus Eriensis;* the Eurypterida, by *Eurypterus Beecheri;* the Phyllocarida, by:

Echinocaris condylepis.
Echinocaris socialis.
Elymocaris siliqua.
Tropidocaris bicarinata.
Tropidocaris interrupta.
Dipterocaris Procne.
Dipterocaris pes-cervæ.

* See page 27, volume VII Palæontology of New York.

And the Cirripedia, by the species *Turrilepas* (?) *Newberryi.* A total of eleven species.*

Catskill Group.

The sandstones of the town of Andes, Delaware county, and of Meshoppen, Wyoming county, Pennsylvania, have furnished specimens of the only known Crustacean from this formation, *Stylonurus excelsior.*

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* The present report contains the description of a species of Bronteus from this group by Mr. J. M. Clarke.

SYNOPTICAL TABLE TO THE GENERA AND SPECIES OF DEVONIAN CRUSTACEA DESCRIBED IN VOLUME VII.

Serial number.	Species number.	NAME AND AUTHOR.	Oriskany.	Schoharie.	Corniferous.	Marcellus.	Hamilton.	Tully.	Genesee.	Portage.	Chemung.	Catskill.	Page.	Plate and figure.
		TRILOBITA.												
		Calymenidæ.												
	1	Calymene, Brongniart.												
1	1	C. platys, Green	.	*	*	.	.	.	.	.	.	.	1	i, 1-9; xxv, 1, 2.
			....	1	1	....	....	....	....	....	....	....		
	2	Homalonotus, Kœnig.												
2	1	H. major, Whitfield	*	.	.	.	.	.	.	.	.	.	4	v a, 1.
3	2	H. Dekayi, Green	.	.	.	*	*	.	.	.	.	.	7	ii, 1-12; iii, 1-5; iv, 1-7; v, 1-14.
			1	....	....	1	1	....	....	....	....	....		
		Bronteidæ.												
	3	Bronteus, Goldfuss.												
4	1	B. Tullius, Hall	.	.	.	.	.	*	.	.	.	.	12	viii a, 34-36.
			....	....	....	....	....	....	1	....	....	....		
		Phacopidiæ.												
	4	Phacops, Emmrich.												
5	1	P. cristata, Hall	*	*	*	.	.	.	.	.	.	.	14	vi, 1-13, 16-29; viii a, 1-4.
6	2	P. cristata, var. pipa, Hall	.	.	*	.	.	.	.	.	.	.	18	viii a, 5-18.
7	3	P. rana, Green	.	.	*?	*	*	*	.	.	.	.	19	vii, 1-11; viii, 1-18; viii a, 21-33.
8	4	P. bufo, Green	.	.	.	.	*	.	.	.	.	.	26	viii, 25, 26.
9	5	P. cacapoua, Hall	.	.	.	.	*	.	.	.	.	.	27	viii, 19-24.
10	6	P. nupera, Hall	.	.	.	.	.	.	.	.	*?	.	27	viii, 27.
			1	1	3	1	3	1	....	...	1	....		
	5	Dalmanites, Barrande.												
11	1	D. (Hausmannia) pleuroptyx, Green	*	.	*	.	.	.	.	.	.	.	28	xi a, 1-3.
12	2	D. (Hausmannia) concinnus, Hall	.	*	*	.	.	.	.	.	.	.	30	xi a, 9-11.
13	3	D. (Hausmannia) concinnus, var. serrula, Hall	.	.	*	.	.	.	.	.	.	.	30	xi a, 12.
14	4	D. (Hausmannia) phacoptyx, Hall	.	.	*	.	.	.	.	.	.	.	31	xi a, 23-27.
15	5	D. (Hausmannia) Meeki, Walcott	.	.	.	.	*?	.	.	.	.	.	32	xi a, 28-30.
16	6	D. (Coronura) aspectans, Conrad	.	.	*	.	.	.	.	.	.	.	33	xiii, 1-11, 13.

17	7	D. (Coronura) myrmecophorus, Green	.	.	*	.	.	.	.	.	.	.	37	xi a, 13; xiii, 12; xiv, 1-6; xv, 1-4.
18	8	D. (Coronura?) emarginatus, Hall	.	*	.	.	.	.	.	.	.	.	40	xi a, 7, 8.
19	9	D. (Cryphæus) comis, Hall	.	.	*	.	.	.	.	.	.	.	41	xvi a, 1.
20	10	D. (Cryphæus) Pleione, Hall	.	.	.	.	*	.	.	.	.	.	41	xvi a, 2.
21	11	D. (Cryphæus) Boothi, Green	.	.	*?	*	*	.	.	.	.	.	42	xvi, 1-4; xvi a, 3-8.
22	12	D. (Cryphæus) Boothi, var. Calliteles, Green	.	.	.	.	*	*	.	.	.	.	45	xvi, 5-22; xvi a, 9-17.
23	13	D. (Cryphæus) Barrisi, Hall	.	.	.	.	*	.	.	.	.	.	48	xvi a, 18.
24	14	D. (Odontocephalus) selenurus, Conrad	.	.	*	.	.	.	.	.	.	.	49	xi b, 15-21; xii, 1-13.
25	15	D. (Odontocephalus) bifidus, Hall	.	.	*	.	.	.	.	.	.	.	53	xi b, 22-25.
26	16	D. (Odontocephalus) Ægeria, Hall	.	.	*	.	.	.	.	.	.	.	53	xi b, 1-11.
27	17	D. (Odontocephalus?) coronatus, Hall	.	.	*	.	.	.	.	.	.	.	54	xi b, 12-14.
28	18	D. (Corycephalus) regalus, Hall	.	*	.	.	.	.	.	.	.	.	55	xi, 1-4.
29	19	D. (Corycephalus) pygmæus, Hall	.	.	*	.	.	.	.	.	.	.	56	xi, 5-8.
30	20	D. (Chasmops) anchiops, Green	*	*	*	.	.	.	.	.	.	.	59	ix, 1-6, 10, 12, 13; x, 1-14.
31	21	D. (Chs.) anchiops, var. armatus, Hall	.	*	*	.	.	.	.	.	.	.	62	ix, 7-9; x, 14.
32	22	D. (Chs.) anchiops, var. sobrinus, Hall	.	*	.	.	.	.	.	.	.	.	62	ix, 11.
33	23	D. (Chasmops) Calypso, Hall	.	.	*	.	.	.	.	.	.	.	64	xi a, 19-22.
34	24	D. (Chasmops?) Erina, Hall	.	.	*	.	.	.	.	.	.	.	67	xi a, 16-18.
35	25	D. (Chasmops) macrops, Hall	.	.	*	.	.	.	.	.	.	.	68	xi a, 14-15.
			2	7	21	2	8	2	....	....	1	....		
		Acidaspidæ.												
	6	Acidaspis, Murchison.												
36	1	A. Calicera, Hall	.	*	*	.	.	.	.	.	.	.	69	xvi b, 1-13.
37	2	A. sp.	.	.	*	.	.	.	.	.	.	.	71	xvi b, 14.
38	3	A. Romingeri, Hall	.	.	.	.	*	.	.	.	.	.	71	xvi b, 15-18.
			....	1	2	...	1	....	....	....	....	....		
		Lichadæ.												
	7	Lichas, Dalman.												
39	1	L. (Terataspis) grandis, Hall	.	*	*	.	.	.	.	.	.	.	73	xvii, 1-6; xviii, 1, 2; xix, 1-7.
40	2	L. (Conolichas) hispidus, Hall	.	*	*	.	.	.	.	.	.	.	77	xix a, 14, 17, 18.
41	3	L. (Conolichas) Eriopis, Hall	.	.	*	.	.	.	.	.	.	.	78	xix, a 2-13, 15, 16.
42	4	L. (Hoplolichas) hylæus, Hall	.	.	*	.	.	.	.	.	.	.	81	xix b, 1, 2.
43	5	L. (Arges) contusus, Hall	.	.	*	.	.	.	.	.	.	.	83	xix b, 3-6.
44	6	L. (Ceratolichas) gryps, Hall	.	.	*	.	.	.	.	.	.	.	84	xix b, 7-13.
45	7	L. (Ceratolichas) dracon, Hall	.	.	*	.	.	.	.	.	.	.	85	xix b, 14-17.
			....	2	7	....	....	....	....	...	....	....		
		Proëtidæ.												
	8	Proëtus, Steininger.												
46	1	P. Conradi, Hall	.	*	.	.	.	.	.	.	.	.	89	xx, 9; xxi, 27, 28; xxii, 4.
47	2	P. angustifrons, Hall	.	*	.	.	.	.	.	.	.	.	91	xx, 1-5; xxii, 1-3.
48	3	P. Hesione, Hall	.	*	.	.	.	.	.	.	.	.	93	xx, 15, 16.
49	4	P. sp.?	.	*	.	.	.	.	.	.	.	.	94	xxii, 5, 6.
50	5	P. curvimarginatus, Hall	.	*	.	.	.	.	.	.	.	.	94	xxii, 13-19.
51	6	P. latimarginatus	.	*	.	.	.	.	.	.	.	.	97	xxii, 7-12.
52	7	P. crassimarginatus, Hall	.	*	*	.	.	.	.	.	.	.	99	xx, 6-8, 20-31; xx, 20-26; xxv, 8.
53	8	P. folliceps, Hall	.	.	*	.	.	.	.	.	.	.	101	xxiii, 3-8.
54	9	P. clarus, Hall	.	.	*	.	.	.	.	.	.	.	104	xx, 12-14; xxiii, 28-30.

SYNOPTICAL TABLE TO THE GENERA AND SPECIES OF DEVONIAN CRUSTACEA, ETC.—(*Continued*).

Serial number.	Species number.	NAME AND AUTHOR.	Oriskany.	Schoharie.	Corniferous.	Marcellus.	Hamilton.	Tully.	Genesee.	Portage.	Chemung.	Catskill.	Page.	Plate and figure.
		Proëtidæ—(*Continued*).												
55	10	P. canaliculatus, Hall	.	.	*	.	.	.	.	.	.	.	107	xx, 10, 11; xxiii, 10, 11.
56	11	P. Verneuili, Hall	.	.	*	.	.	.	.	.	.	.	108	xx, 18, 19.
57	12	P. microgemma, Hall	.	.	*	.	.	.	.	.	.	.	109	xxii, 33, 34.
58	13	P. stenopyge, Hall	.	.	*	.	.	.	.	.	.	.	110	xxii, 27.
59	14	P. ovifrons, Hall	.	.	*	.	.	.	.	.	.	.	110	xxii, 31, 32.
60	15	P. delphinulus, Hall	.	.	*	.	.	.	.	.	.	.	111	xxiii, 1, 2; xxv, 6.
61	16	P. (?) planimarginatus, Meek	.	.	*	.	.	.	.	.	.	.	112	xxiii, 12.
62	17	P. tumidus, Hall	.	.	*	.	.	.	.	.	.	.	113	xxiii, 9.
63	18	P. Haldemani, Hall	.	.	.	*	*	.	.	.	.	.	113	xxi, 7-9; xxiii, 13-15.
64	19	P. macrocephalus, Hall	.	.	.	*	*	*	.	.	.	.	116	xxi, 10-21; xxiii, 30, 31.
65	20	P. Rowi, Green	.	.	.	.	*	*	.	.	.	.	119	xxi, 2-6, 24-26; xxiii, 20-29.
66	21	P. jejunus, Hall	.	.	.	.	*	.	.	.	.	.	124	xxv, 7.
67	22	P. Phocion, Billings	.	.	.	.	*	.	.	.	.	.	125	xxv, 9, 10.
68	23	P. Prouti, Shumard	.	.	.	.	*	.	.	.	.	.	126	xxiii, 16-18.
69	24	P. Nevadæ, Hall	.	.	.	.	*?	.	.	.	.	.	129	xxiii, 19.
70	25	P. occidens, Hall	.	.	.	.	*	.	.	.	.	.	130	xxi, 22, 23.
71	26	P. (?) longicadus	.	.	.	.	*?	.	.	.	.	.	131	xx, 32-34.
			....	7	11	2	9	2	....	....	....	....		
	9	Phaëthonides, Anglin.												
72	1	Ph. arenicolus, Hall	.	*	*	.	.	.	.	.	.	.	134	xxv, 12, 13.
73	2	Ph. varicella, Hall	.	.	*	.	.	.	.	.	.	.	135	xxiv, 29-31.
74	3	Ph. gemmæus, Hall	.	.	*	.	*	.	.	.	.	.	136	xxiv, 32-36.
75	4	Ph. (?) denticulatus, Meek	.	.	.	.	*?	.	.	.	.	.	139	xxv, 14, 15.
			....	1	3	....	2	....	....	....	....	....		
	10	Cyphaspis, Burmeister.												
76	1	C. minuscula, Hall	.	*	*	.	.	.	.	.	.	.	140	xx, 17; xxiv, 7-12.
77	2	C. stephanophora, Hall	.	.	*	.	.	.	.	.	.	.	142	xxiv, 2-6.
78	3	C. diadema, Hall	.	.	*	.	.	.	.	.	.	.	144	xxiv, 13.
79	4	C. hybrida, Hall	.	.	*	.	.	.	.	.	.	.	144	xxiv, 14.
80	5	C. ornata, Hall	.	.	.	.	*	.	.	.	.	.	145	xxi, 1; xxiv, 21.
81	6	C. ornata, var. baccata, Hall	.	.	.	.	*	.	.	.	.	.	146	xxiv, 22, 23.

82	7	C. craspedota, Hall					*						148	xxiv, 15-20.
83	8	C. lævis, Hall									*		150	xxi, 29.
			....	1	4	...	3	....	....	....	1	....		
		XIPHOSURA. *Limulidæ.*												
	11	Protolimulus, Packard.												
84	1	P. Eriensis, Williams									*		153	xxvii, 1, 2.
			....	....	....	...	....	....	....	....	1	....		
		EURYPTERIDA. *Eurypteridæ.*												
	12	Eurypterus, Dekay.												
85	1	E. Beecheri, Hall									*		156	xxvii, 5.
			....	....	....	....	....	....	....	....	1	....		
	13	Stylonurus, Page.												
86	1	S. excelsior, Hall	....	....	....	....	....	....	....	.. .	....	*	{ 158 221	} xxvi, xxvi a, 1-3.
87	2	S. ? (Echinocaris?) Wrightianus, Dawson	....	....	....	....	....	....	....	*	....	....	160	xxvii, 7-9.
			....	....	....	....	....	....	....	1	....	....		
		PHYLLOCARIDA. *Ceratiocaridæ.*												
	14	Ceratiocaris, McCoy.												
88	1	C. longicauda, Hall							*				163	xxxi, 1.
89	2	C. Beecheri, Clarke								*			164	xxxi, 3.
90	3	C.? simplex, Clarke								*			165	xxxi, 2.
			....	....	....	....	....	....	1	2	....	....		
	15	Echinocaris, Whitfield.												
91	1	E. punctata, Hall					*						166	xxvii, 10; xxviii, 1-7; xxix, 1-8.
92	2	E. Whitfieldi, Clarke								*			172	xxix, 20, 21.
93	3	E. condylepis, Hall									*		173	xxix, 14-17.
94	4	E. socialis, Beecher									*		174	xxx, 1-12.
95	5	E. sublævis, Whitfield								*			176	xxix, 11-13.
96	6	E. pustulosa, Whitfield								*			178	xxix, 9, 10.
97	7	E. multinodosa, Whitfield								*			180	xxix, 18, 19.
			....	....	....	....	1	....	....	4	2	....		
	16	Elymocaris, Beecher.												
98	1	E. capsella, Hall					*						181	xxxi, 4.
99	2	E. siliqua									*		182	xxxi, 5, 6.
			....	....	....	....	1	....	....	....	1	....		

SYNOPTICAL TABLE TO THE GENERA AND SPECIES OF DEVONIAN CRUSTACEA, ETC.— (*Concluded*).

Serial number.	Species number.	NAME AND AUTHOR.	Oriskany.	Schoharie.	Corniferous.	Marcellus.	Hamilton.	Tully.	Genesee.	Portage.	Chemung.	Catskill.	Page.	Plate and figure.
	17	Tropidocaris, Beecher.												
100	1	T. bicarinata, Beecher	.	.	.	.	.	.	.	.	*	.	184	xxxi, 7-12.
101	2	T. interrupta, Beecher	.	.	.	.	.	.	.	.	*	.	185	xxxi, 13.
			....	....	....	....	....	....	....	....	2	...		
		Pinacaridæ.												
	18	Mesothyra.												
102	1	M. Oceani, Hall	.	.	.	.	.	.	.	*	.	.	187	xxxii, 1-6; xxxiii, 4-7; xxxiv, 1-5.
103	2	M. Neptuni, Hall	.	.	.	.	*	.	.	.	.	.	191	xxxii, 7; xxxiii, 1.
104	3	M. spumæa, Hall	.	.	.	.	*	.	.	.	.	.	193	xxxii, 8, 9; xxxiv, 2.
105	4	M. (Dithyrocaris) Veneris, Hall	.	.	.	*	.	.	.	.	.	.	193	xxxiii, 3.
106	5	(Dithyrocaris Belli, Woodward)	.	.	.	.	*	.	.	.	.	.	194	
			....	....	....	1	3	....	....	1	....	....		
		Rhinocaridæ.												
	19	Rhinocaris, Clarke.												
107	1	R. columbina, Clarke	.	.	.	.	*	.	.	.	.	.	195	xxxi, 16-21.
108	2	R. scaphoptera, Clarke	.	.	.	.	*	.	.	.	.	.	197	xxxi, 22, 23.
			....	....	....	....	2	....	....	....	....	...		
		Discinocaridæ.												
	20	Spathiocaris, Clarke.												
109	1	S. Emersoni, Clarke	.	.	.	.	.	.	.	*	.	.	199	xxxv, 12-18.
			....	....	....	....	....	....	....	1	....	....		
	21	Dipterocaris, Clarke.												
110	1	D. pennæ-Dædali, Clarke	.	.	.	.	.	.	.	*	.	.	200	xxxv, 24.
111	2	D. Procne, Clarke	.	.	.	.	.	.	.	*	*	.	201	xxxv, 25-27.
112	3	D. pes-cervæ, Clarke	.	.	.	.	.	.	.	.	*	.	202	xxxv, 20, 21.
			...	....	....	....	....	....	....	2	2	....		

		DECAPODA. *Carididæ.*												
	22	Palæopalæmon, Whitfield.												
113	1	P. Newberryi, Whitfield	.	.	.	.	.	.	.	*	.	.	203	xxx, 20-23.
			....	....	....	....	....	....	....	1	....	....		
		PHYLLOPODA. *Limnadiadæ.*												
	23	Estheria, Rüppell.												
114	1	E. pulex, Clarke	.	.	.	.	*	.	.	.	.	.	206	xxxv, 10, 11.
			....	....	....	....	1	....	....	....	....	....		
	24	Schizodiscus, Clarke.												
115	1	S. capsa, Clarke	.	.	.	.	*	.	.	.	.	.	207	xxxv, 1-9.
			....	....	....	....	1	....	....	....	....	....		
		CIRRIPEDIA. *Balanidæ.*												
	25	Protobalanus, Whitfield.												
116	1	P. Hamiltonensis, Whitfield	.	.	.	*	.	.	.	.	.	.	209	xxxvi, 23.
			....	....	....	1	....	....	....	....	....	....		
	26	Palæocreusia, Clarke.												
117	1	P. Devonicus, Clarke	.	.	*	.	.	.	.	.	.	.	210	xxxvi, 24-26.
			....	....	1	....	....	....	....	....	....	....		
		Lepadidæ.												
	27	Strobilepis, Clarke.												
118	1	S. spinigera, Clarke	.	.	.	.	*	.	.	.	.	.	212	xxxvi, 20-22.
			....	....	....	....	1	....	....	....	....	....		
	28	Turrilepas, Woodward.												
119	1	T. flexuosus, Hall	.	.	*	.	.	.	.	.	.	.	215	xxxvi, 1.
120	2	T. cancellatus, Hall	.	.	*	.	.	.	.	.	.	.	216	xxxvi, 2.
121	3	T. Devonicus, Clarke	.	.	.	.	*	.	.	.	.	.	216	xxxvi, 3.
122	4	T. squama, Hall	.	.	.	.	*	.	.	.	.	.	217	xxxvi, 5-8.
123	5	T. nitidulus, Hall	.	.	.	.	*	.	.	.	.	.	218	xxxvi, 4.
124	6	T. foliatus, Hall	.	.	.	.	*	.	.	.	.	.	218	xxxvi, 15.
125	7	T. tener, Hall	.	.	.	.	*	.	.	.	.	.	219	xxxvi, 9-14.
126	8	T. (?) Newberryi, Whitfield	.	.	.	.	.	.	.	*	.	.	219	xxxvi, 16-19.
			....	....	2	....	5	....	....	1	....	....		

GENERA AND SPECIES, NOT DEVONIAN, DESCRIBED OR ILLUSTRATED IN THIS VOLUME.

Serial number.	—	NAME AND AUTHOR.	Clinton.	Niagara.	Lower Helder-berg.	Lower carbonif-erous.	Page.	Plate and figure.
127	......	Calymene Niagarensis, Hall	.	*	.	.	......	i, 10-14.
128	......	Homalonotus Vanuxemi, Hall	.	.	*	.	11	v b, 1, 2.
129	......	Phacops Logani, Hall	.	.	*	.	......	
130	......	Dalmanites (Hausmannia) pleuroptyx, Green	.	.	*	.	28	xi a, 1-3.
131	......	D. (Coryccphalus) dentatus, Barrett	.	.	*	.	58	xi a, 4-6.
132	......	Lichas (Dicranogmus) ptyonurus, Hall	.	*	.	.	86	xix b, 19-21.
133	......	L. (Conolichas) pustulosus, Hall	.	.	*	.	80	xix, 8, 10, 11.
134	......	L. (Conolichas) Bigsbyi, Hall	.	.	*	.	80	xix a, 1.
135	......	L. (Conolichas?) sp.?	.	.	*	.	80	xix, 9.
136	......	Proëtus Missouriensis, Shumard	.	.	.	*	133	xxiii, 32.
137	......	Phaëthonides cyclurus, Hall	.	.	*	.	137	xxiv, 26-28; **xxv**, 11.
138	......	Ph. Macrobius, Billings	.	.	*	.	......	xxiv.
139	......	Cyphaspis cœlebs, Hall	.	.	*	.	151	xxiv, 1.
140	......	Phillipsia, sp.?	.	.	.	*	......	xxiii.
141	......	Eurypterus prominens, Hall	*	.	.	.	157	xxvii, 3, 4.
142	......	E. approximatus, Hall	.	.	.	*	......	xxvii, 6.
143	......	Tropidocaris alternata, Beecher	.	.	.	*	168	xxxi, 14, 15.
			1	2	10	4		

SUMMARY OF THE NORTH AMERICAN DEVONIAN CRUSTACEA (EXCLUSIVE OF THE OSTRACODA).

	Number of species.	NAME.	Oriskany.	Schoharie.	Corniferous.	Marcellus.	Hamilton.	Tully.	Genesee.	Portage.	Chemung.	Catskill.
I	1	Calymene	.	1	1	.	.	.	.	.	.	.
II	2	Homalonotus	1	.	.	1	1	.	.	.	.	.
III	1	Bronteus	.	.	.	.	.	1	.	.	.	.
IV	6	Phacops	1	1	3?	1	3	1	.	.	1	.
V	25	Dalmanites	2	6	18?	1	5?	1	.	.	.	.
VI	5	D. (Hausmannia)	1	1	4	.	1?	.	.	.	.	.
VII	3	D. (Coronura)	.	1	2	.	.	.	.	.	.	.
VIII	5	D. (Cryphæus)	.	.	2?	1	4	1	.	.	.	.
IX	4	D. (Odontocephalus)	.	.	4	.	.	.	.	.	.	.
X	2	D. (Corycephalus)	.	1	1	.	.	.	.	.	.	.
XI	6	D. (Chasmops)	1	3	5	.	.	.	.	.	.	.
XII	3	Acidaspis	.	1	2	.	1	.	.	.	.	.
XIII	7	Lichas	.	2	7	.	.	.	.	.	.	.
XIV	1	L. (Terataspis)	.	1	1	.	.	.	.	.	.	.
XV	2	L. (Conolichas)	.	1	2	.	.	.	.	.	.	.
XVI	1	L. (Hoplolichas)	.	.	1	.	.	.	.	.	.	.
XVII	1	L. (Arges)	.	.	1	.	.	.	.	.	.	.
XVIII	2	L. (Ceratolichas)	.	.	2	.	.	.	.	.	.	.
XIX	26	Proëtus	.	7	11	2	9?	2	.	.	.	.
XX	4	Phaëtonides	.	1	3	.	2?	.	.	.	.	.
XXI	8	Cyphaspis	.	1	4	.	3	.	.	.	1	.
	83	(Total Trilobita)	4	20	49	5	24	5	0	0	2	0
XXII	1	Protolimulus	.	.	.	.	.	.	.	.	1	.
XXIII	1	Eurypterus	.	.	.	.	.	.	.	.	1	.
XXIV	2	Stylonurus	.	.	.	.	.	.	.	1	.	1
XXV	3	Ceratiocaris	.	.	.	.	.	.	1	2	.	.
XXVI	7	Echinocaris	.	.	.	.	1	.	.	4	2	.
XXVII	2	Elymocaris	.	.	.	.	1	.	.	.	1	.
XXVIII	2	Tropidocaris	.	.	.	.	.	.	.	.	2	.
XXIX	4	Mesothyra	.	.	.	1	2	.	.	1	.	.
XXX	1	Dithyrocaris	.	.	.	.	1	.	.	.	.	.
XXXI	2	Rhinocaris	.	.	.	.	2	.	.	.	.	.
XXXII	1	Palæopalæmon	.	.	.	.	.	.	.	1	.	.
XXXIII	1	Spathiocaris	.	.	.	.	.	.	.	1	.	.
XXXIV	3	Dipterocaris	.	.	.	.	.	.	.	2	2	.
XXXV	1	Estheria	.	.	.	.	1	.	.	.	.	.
XXXVI	1	Schizodiscus	.	.	.	.	1	.	.	.	.	.
XXXVII	1	Protobalanus	.	.	.	1	.	.	.	.	.	.
XXXVIII	1	Palæocreusia	.	.	1	.	.	.	.	.	.	.
XXXIX	1	Strobilepis	.	.	.	.	1	.	.	.	.	.
XL	8	Turrilepas	.	.	2	.	5	.	.	1		.
	126	Total	4	20	52	7	39	5	1	13	11	1

A List of the Type Specimens of Devonian Crustacea described in Palæontology of New York, Vol. VII, in the possession of the New York State Museum of Natural History.

[Where the specimen is represented by a cast only the number of the figure is marked by a star (*).]

Plate I.—*Calymene platys.* Figs. 1, 2, 3–6–7, 4, 5, 8, 9.
Plate II.—*Homalonotus Dekayi.* Figs. 1, 2, 6, 7, 8–9, 11, 12.
Plate III.—*Homalonotus Dekayi.* Figs. 1, 2, 3, 4, 5.
Plate IV.—*Homalonotus Dekayi.* Figs. 1, 2, 3, 6, 7.
Plate V.—*Homalonotus Dekayi.* Figs. 1, 2–3, 12-13.
Plate V a.—*Homalonotus major.* Fig. 1.
Plate V b.—*Homalonotus Vanuxemi.* Figs. 1–2.
Plate VI.—*Phacops cristata.* Figs. 1, 2, 3–4, 5, 6–7, 9, 12–13, 26, 27, 28, 29.
Plate VII.—*Phacops rana.* Figs. 1, 5, 6, 7–8, 9, 10, 11.
Plate VIII.—*Phacops rana.* Figs. 11, 13, 15, 16–17, 18.
Phacops bufo. Figs. 25*–26*.
Plate VIII a.—*Phacops cristata.* Figs. 1–2, 3, 4.
Phacops cristata var. *pipa.* Figs. 5, 6–7, 9, 10, 11–12, 13, 14 15, 16, 17, 18.
Phacops Logani. Figs. 19, 20.
Phacops rana. Figs. 21, 22, 28, 29, 30, 31, 32, 33.
Bronteus Tullius. Figs. 34*–35.*
Plate IX.—*Dalmanites* (*Chasmops*) *anchiops.* Figs. 2–3, 4–5–6, 12.
Dalmanites (*Chasmops*) *anchiops* var. *armatus.* Figs. 7, 8, 9.
Dalmanites (*Chasmops*) *anchiops* var. *sobrinus.* Fig. 11.
Plate X.—*Dalmanites* (*Chasmops*) *anchiops.* Figs. 5, 8–9, 10, 11, 12, 13.
Plate XI.—*Dalmanites* (*Corycephalus*) *pygmæus.* Figs. 5–6, 7–8.
Plate XI a.—*Dalmanites* (*Hausmannia*) *pleuroptyx.* Figs 1, 3.
Dalmanites (*Corycephalus*) *dentatus.* Figs. 5, 6.
Dalmanites (*Coronura*) *emarginatus.* Figs. 7, 8.
Dalmanites (*Hausmannia*) *concinnus.* Figs. 9, 10–11.
Dalmanites (*Chasmops*) *Erina.* Figs. 16–17, 18.
Dalmanites (*Chasmops*) *Calypso.* Figs. 19*–20*, 22.
Dalmanites (*Hausmannia*) *phacoptyx.* Figs. 23*–24*, 26.
Dalmanites (*Hausmannia*) *Meeki.* Figs. 28*, 29*–30*.
Plate XI b.—*Dalmanites* (*Odontocephalus*) *Ægeria.* Figs. 5, 6.
Dalmanites (*Odontocephalus*) *selenurus.* Figs. 14, 15, 16–17, 18, 19, 21.
Dalmanites (*Odontocephalus*) *bifidus.* Figs. 22, 23, 24–25.
Plate XII.—*Dalmanites* (*Odontocephalus*) *selenurus.* Figs. 5–6, 7, 8–9, 10-11, 12.
Plate XIII.—*Dalmanites* (*Coronura*) *aspectans.* Figs. 3–4, 5, 9, 13.
Dalmanites (*Coronura*) *myrmecophorus.* Fig. 12.
Plate XIV.—*Dalmanites* (*Coronura*) *myrmecophorus.* Figs. 1, 2, 3, 4–5–6,
Plate XV.—*Dalmanites* (*Coronura*) *myrmecophorus.* Fig. 4,

Plate XVI.—*Dalmanites* (*Cryphæus*) *Boothi*. Figs. 1–2, 3, 4.
Dalmanites (*Cryphæus*) *Boothi* var. *Calliteles*. Figs. 5, 6, 7, 8, 9–14–15, 10–12, 13, 16, 17, 19–20–21, 22.

Plate XVI a.—*Dalmanites* (*Cryphæus*) *Boothi*. Figs. 4, 5, 6, 7, 8 (=xvi—1).
Dalmanites (*Cryphæus*) *Boothi*, var. *Calliteles*. Figs. 12 (=xvi—5), 13 (=xvi—6), 14 (=xvi—7), 15, 16, 17.

Plate XVI b.—*Acidaspis callicera*. Figs. 3–4–5–6–7, 9.
Acidaspis, sp. Fig. 14.
Acidaspis Romingeri. Figs. 15*–16*–17*–18*.

Plate XVIII.—*Lichas* (*Terataspis*) *grandis*. Figs. 2, 3, 4-5.

Plate XIX.—*Lichas* (*Terataspis*) *grandis*. Figs. 1, 2, 3, 4, 5, 6, 7.
Lichas (*Conolichas*) *pustulosus*. Figs. 10, 11.
Lichas (*Conolichas ?*) sp.? Fig. 9.

Plate XIX a.—*Lichas* (*Conolichas*) *Bigsbyi* (?). Fig. 1*.
Lichas (*Conolichas*) *Eriopis*. Figs. 2–3–4–5, 7, 8, 9, 11, 13-15–1
Lichas (*Conolichas*) *hispidus*. Figs. 14, 17, 18.

Plate XIX b.—*Lichas* (*Arges*) *contusus*. Figs. 3, 4–5–6.
Lichas (*Ceratolichas*) *gryps*. Figs. 7–8, 9–10–11–12–12 a–136
Lichas (*Ceratolichas*) *dracon*. Figs. 14–15, 16–17, 18–18 a.
Lichas (*Dicranogmus*) *ptyonurus*. Fig. 20.

Plate XX.—*Proetus angustifrons*. Figs. 1, 2, 3, 4–5.
Proetus crassimarginatus. Figs. 6, 7–8, 23, 24, 27.

Plate XXI.—*Proetus Rowi*. Figs. 5, 25, 26.
Proetus Haldemani. Figs. 7*–8*.
Proetus macrocephalus. Figs. 13, 14, 17, 18, 19, 24.

Plate XXII.—*Proetus angustifrons*. Figs. 1, 2.
Proetus Conradi. Fig. 4.
Proetus sp. Figs. 5, 6.
Proetus latimarginatus. Figs. 7, 8, 9, 10, 11, 12.
Proetus curvimarginatus. Figs. 13, 14–15, 16, 17, 18–19.
Proetus crassimarginatus. Figs. 20, 21.
Proetus stenopyge. Fig. 27.
Proetus clarus. Figs. 28, 29.
Proetus ovifrons. Figs. 31, 32.
Proetus microgemma. Figs. 33, 34.

Plate XXIII.—*Proetus folliceps*. Figs. 3–4–8, 5.
Proetus tumidus. Fig. 9.
Proetus planimarginatus. Fig. 12*
Proetus Haldemani. Figs. 13, 15* (=xxi, 7*–8*).
Proetus Prouti. Figs. 16*–17*, 18*.
Proetus Nevadæ. Fig. 19*.
Proetus Rowi. Figs. 20, 22, 23, 24, 26, 27, 28, 29.
Proetus macrocephalus. Figs. 30, 31.
Proetus Missouriensis. Fig. 32.

Plate XXIV.—*Cyphaspis coelebs*. Fig. 1.
Cyphaspis stephanophora. Figs. 2–3, 4, 5, 6.
Cyphaspis minuscula. Figs. 7, 8–9, 10, 11, 12.
Cyphaspis diadema. Fig. 13.
Cyphaspis hybrida. Fig. 14.
Cyphaspis craspedota. Figs. 15–16–17, 18–19, 20.
Cyphaspis ornata. Fig. 21.

Plate XXIV.— *Cyphaspis ornata*, var. *baccata*. Figs. 22, 23.
Phaethonides Macrobius. Fig. 24.
Phaethonides cyclurus. Figs. 26, 27, 28.
Phaethonides varicella. Figs. 29, 30, 31.
Phaethonides gemmæus. Figs. 32, 33, 35, 36.

Plate XXV.—*Proetus delphinulus*. Fig. 6*.
Proetus Phocion. Figs. 9*, 10*.
Phaethonides cyclurus. Fig. 11.
Phaethonides arenicolus. Fig. 12*.

Plate XXVI.—*Stylonurus excelsior*. Fig. 1*.

Plate XVIXa.—*Stylonurus excelsior*. Figs. 1*–2*–3*.

Plate XXVII.—*Eurypterus prominens*. Figs. 3*–4*.
Eurypterus Beecheri. Fig. 5*.
Eurypterus approximatus. Fig. 6*.
Stylonurus (?) (*Echinocaris?*) *Wrightianus*. Figs. 7*–8*–9*.
Echinocaris punctata. Fig. 10 (=xxviii—4)

Plate XXVIII.—*Echinocaris punctata*. Figs. 1, 2, 3, 4, 5, 6–7.

Plate XXIX.—*Echinocaris punctata*. Figs. 1–2, 3, 4, 5, 6 (=xxviii—2), 7, 8
Echinocaris pustulosa. Figs. 9*–10*.
Echinocaris sublævis. Figs. 11*–12*.
Echinocaris condylepis. Figs. 14–15, 16–17.
Echinocaris multinodosa. Figs. 18*, 19*.

Plate XXX.—*Echinocaris socialis*. Figs. 7, 10.
Mandibles of Phyllocarida. Figs. 13, 14, 15, 16, 17, 18, 19.
Palæopalæmon Newberryi. Figs. 20*–21*–22*–23*.
Tropidocaris Hamiltoniæ. Figs. 24–25.

Plate XXXI.—*Ceratiocaris longicauda*. Fig. 1.
Elymocaris siliqua. Fig. 6*.
Tropidocaris bicarinata. Figs. 7*–9*, 8–10, 11*.
Tropidocaris interrupta. Fig. 13*.
Tropidocaris alternata. Figs. 14*, 15*.
Rhinocaris columbina. Figs. 16–17, 18–19, 20.
Rhinocaris scaphoptera. Figs. 22–23.

Plate XXXII.—*Mesothyra Oceani*. Figs. 1 (=xxxiii—4), 2 (=xxxiii—4) 3 (=xxxiii—5), 4 (=xxxiii—4), 5 (=xxxiv—4) 6 (=xxxiii—4).
Mesothyra Neptuni. Fig. 7 (=xxxiii—1).
Mesothyra spumæa. Figs. 8–9.

Plate XXXIII.—*Mesothyra Neptuni*. Fig. 1.
Mesothyra spumæa. Fig. 2.
Mesothyra (*Dithyrocaris*) *Veneris*. Fig. 3.
Mesothyra Oceani. Figs. 4, 5, 6, 7.

Plate XXXIV.—*Mesothyra Oceani*. Figs. 1, 2, 3, 4, 5.

Plate XXXV.—*Schizodiscus capsa*. Figs. 1–2, 3–4, 5, 6, 7–8, 9.
Estheria pulex. Figs. 10–11.
Spathiocaris Emersoniæ. Figs. 12, 13, 14, 15, 16, 17, 18, 19.
Dipterocaris pes-cervæ. Figs. 20–21, 22–23.
Dipterocaris pennæ-Dædali. Fig. 24.
Dipterocaris procne. Figs. 25, 26–27.

Plate XXXVI.—*Turrilepas cancellatus.* Fig. 2.
Turrilepas devonicus. Fig. 3.
Plate XXXVI.—*Turrilepas nitidulus.* Fig. 4.
Turrilepas squama. Figs. 5, 6, 7, 8.
Turrilepas tener. Figs. 9–10–11–12–13, 14.
Turrilepas foliatus. Fig. 15.
Strobilepis spinigera. Figs. 20–21–22.
Palaeocreusia Devonica. Figs. 24–25–26.

Total number type specimens	348
Total number casts of type specimens	34
	382

PALÆONTOLOGY OF NEW YORK — Volume VIII.

Historical Statement.

During the preliminary studies of the Brachiopoda, now illustrated in volumes III and IV of the Palæontology of New York (the latter in 1867), the author became aware of the necessity of a revision of the genera of this class of fossils as then recognized and described. In the course of this work and in the final preparation of these volumes, he had already proposed the establishment of seventeen new genera, which, though opposed and criticised as being unnecessary or not well founded, have since been adopted in the science. More than this, the recent workers in the same direction of investigation, have seen the necessity of establishing other new genera. Mr. Davidson, the most learned in the Brachiopoda, as well as the most strenuously conservative in his views of generic subdivision, after protesting against the proposed subdivisions, finally yielded to the evidences offered by the study of the interior appendages, hinge structures and the muscular and vascular impressions upon the interior of these fossil shells, and since that period has himself added a considerable number of new genera.

Other workers in this field have departed still more widely from the originally accepted genera of twenty-five years ago; and while new generic types are being discovered, some of the older genera, recognized as established groups, are found to be composed of very heterogeneous material, which requires subdivision.

But while congratulating ourselves that such progress has been achieved during recent years we should not forget to recognize the results published by Pander more than forty years ago. For a long time the generic subdivisions recognized and published by

him were refused acceptance by most of the students and authors on Brachiopoda, and only within a few years are we learning to appreciate the knowledge and acuteness of observation of this Russian author, and to adopt his proposed generic terms.

The work of Pander has been too little known among western students to have received the attention due to its merits.

This appreciation of the then accepted condition of this class of fossils and a recognition of the incompleteness of his own work as presented in volumes III and IV of the Palæontology of New York, prompted the author to propose a supplemental volume which should be mainly devoted to the illustration of generic forms. The work in preparation for this volume was begun immediately after the completion of volume IV; but as the author's duties required the contemporaneous preparation of volume V, it was impossible to give the proper attention to the Brachiopoda.

Nevertheless, the plan was laid out and the plates were arranged and numbered with figures sketched in outline where no drawings existed.

The original plan as thus indicated embraced something over eighty plates of illustration, of which twenty-eight had already been lithographed before the end of 1878. The last plates of the Brachiopoda done previous to 1888 were placed in the hands of the lithographer in July 1878. Besides these there were original drawings already made for a considerable number of plates beyond those lithographed. These drawings have been only in part used in the arrangement of plates up to the time of writing this Report.

The necessity of pushing forward the work for volume V, which was originally planned to embrace the Lamellibranchiata, Gastropoda, Pteropoda and Cephalopoda, precluded any farther attention to the Brachiopoda at that time. Volume V, part ii, was published in 1879.* The work on the Lamellibranchiata, which had been progressed, was continued, so that before the end of 1881 eighty plates had been lithographed. At that time there had also been lithographed thirty-three plates of the Corals and Bryozoa, now constituting a part of volume VI, together with eight plates of Crustacea, now included in volume VII. A considerable part of the manuscript descriptions of the Lamellibranchiata had also been prepared, but as the printing

*The reason for the precedence of part ii over part i has been explained in the preface to the former volume.

was suspended with the close of volume V, part ii, no progress could be made in that direction.

Such was the condition of the work on the Palæontology of New York, when, in 1883, a law was passed* for the completion of the Palæontology in five volumes, but changing the original plan and curtailing the number of pages and plates in each one.

From the fact that so much had already been done in the Brachiopoda in volumes III and IV, it was thought better, in the new arrangement, to postpone that volume till after the completion of volumes V, VI and VII; and to constitute it a separate volume with the title of volume VIII, instead of publishing it as originally intended as part ii, of volume IV.

The completion of the latter volume (VII) in May, 1888, brought us face to face with the problem involved in the preparation and completion of volume VIII.

Before the close of 1886, all the collections of fossils belonging to the State were transferred from my own premises to the State Hall,† and in the earlier part of that year all the Brachiopoda had been sent to the same place and delivered into the charge of Mr. C. E. Beecher, who had been assigned to assist me in the preparation of the volume. Before sending to this new repository, all these fossils had been carefully separated and arranged under three designations, in order to facilitate their arrangement for future use; first the types and typical specimens which had been used in the preparation of volume IV; second, the better specimens of the entire collection which were to be reserved for study and preservation in the Museum, and third, all the remaining duplicate material intended for use in making up collections for the schools and colleges.

Owing to the loss of time of nearly one year, chiefly occupied in the removal of collections, which now occupy the upper floor of the State Hall, and of many boxes now stored in the basement of that building, the publication of the volumes had been retarded and certain money originally appropriated for that purpose had lapsed to the treasury.

* A similar law, regarding publication alone, without restriction as to number of plates or pages of text, was passed by the Senate in 1882, but failed in the House through the opposition of one man.

† These collections had been accumulated in pursuance of the requirements of a law passed in 1855, which was the first authorization for the collection of fossils for the Palæontology of New York.

It became necessary, therefore, to secure the reappropriation of these moneys, to be applied to the purposes originally intended by the law of 1883, before we could proceed with the work of volume VIII. This was finally accomplished through the supply bill passed by the Legislature to which the Governor affixed his signature in May, 1888. We were then free to go on with the work which had so long been suspended. The collections of Brachiopoda delivered at the State Hall in 1886 remained in the same condition as then, no work having been done upon them, and in all essential respects the same as when the work on the Brachiopoda was suspended in 1878. The collection was in fact less available for immediate use, for the reason that it had been separated from other congeneric material with which it had been formerly associated while preparing the earlier plates.

The first requirement, therefore, was to put the Brachiopoda of the Museum Collection into an accessible condition, and to ascertain in what directions it would be necessary to acquire additional material. It should also be remembered that no field collections of importance have been made for the Museum within the past ten years, except some small special collections of Bryozoa and Crustacea; that the field collections previous to that time had been especially made for the Lamellibranchiata, Gastropoda, Cephalopoda and Corals, so that no special attention has ever been given to the collection of Brachiopoda by the State Museum since the completion of volume IV.

With a full knowledge and appreciation of the resources of the State Collections, it became very evident that the requirements for the completion of the volume could never be complied with were we to depend upon making collections in the field. It therefore became necessary to employ every available resource for procuring specimens for illustration, and the writer has been authorized to have collections made in the field, to a limited extent, where practicable; to purchase collections to a small extent, and to make exchanges; to visit and examine all private and public collections accessible, and to borrow from these such specimens as are not otherwise attainable, for the illustration of the volume.

After the passage of the law, reappropriating the lapsed money, Mr. J. M. Clarke immediately began the systematic arrangement of all the available material in the State Museum collections, and sub-

sequently undertook some field work for the special purpose of securing certain terebratuloid forms, and some of the more obscure spire-bearing species. This work has been very successful in the acquisition of an extensive collection of these Brachiopoda. Dr. C. Rominger, of Ann Arbor, has also been employed in making some collections with especial reference to the Brachiopoda of the Hamilton group in its exposure upon Lake Michigan, and later in the season among the older rocks of New York and the adjacent parts of Vermont. Some further information of these collections will be given later on.

Unfortunately the State Museum has no collection of fossils from the Primordial rocks, and since the Brachiopod genera characteristic of that horizon are those to be illustrated on the earlier plates of the volume, I made an unsuccessful effort to obtain from the Museum of Comparative Zoölogy at Cambridge, and from the National Museum at Washington, specimens to illustrate the principal genera of these older rocks. Mr. Geo. F. Matthew, of St. John, New Brunswick, has promised to obtain for the Museum a collection to illustrate the Primordial rocks of that region. This collection has not yet come to hand, and in the meantime Mr. Matthew has kindly loaned to us the use of specimens from his own collection, and we have availed ourselves of such other collections as were within our reach.

At the request of the Secretary of your Board I present the following brief account of my itinerary and its results:

I have visited, among others, the following-named persons and institutions, and have obtained from them much useful material.

Prof. Brownell, of the Syracuse High School, has furnished a collection of specimens of several genera of Brachiopoda of the Trenton limestone in exchange for other fossils.

Some interesting specimens of Brachiopoda were obtained from Mr. E. B. Knapp, of Skaneateles.

Prof. T. B. Stowell, of the High School at Cortland, loaned me some interesting specimens and presented others to the Museum Collection. I also obtained a few specimens from Prof. Lovell, of the Elmira High School.

President Allen, of Alfred University, with his characteristic liberality, placed in my hands, for use in the volume, all his available specimens of Brachiopoda.

In Ann Arbor, Michigan, I obtained from Prof. Winchell the

loan of his type specimens of the genus Syringothyris, and from Dr. C. Rominger other specimens of the same genus. These specimens, together with those before possessed, have enabled us to present a very satisfactory illustration of the generic characters of this interesting spiriferoid form.

The illustrations previously given on plates XXII, XXIII and XXIV, together with the new material constituting plates XXV, XXVI and XXVII, show very clearly the gradual development of certain features, which, beginning in species of the Corniferous limestone, become fully developed in those of the Carboniferous period, constituting the peculiar characteristics of the genus Syringothyris.

Mr. Thomas A. Greene, of Milwaukee, possesses the most complete and remarkable collection of fossils from the Niagara group of Wisconsin and Illinois, known to me in the United States. The collection is preëminently a local one and contains not only great numbers of every species known in the rocks of that region, but they are represented in all varieties of form and conditions of preservation; and each locality of the region has its specimens especially designated.

In some instances one or more drawers of two feet square are devoted to the exhibition of a single species.

I attempted only the examination of the Brachiopoda which are represented in this collection in great numbers* and will at some future day be of the highest importance in the study and illustration of the fauna of the Niagara group in its western phases, and especially of the magnesian limestones of that age in Wisconsin and Illinois.

The species of this class in the western localities are more commonly in the condition of casts of the interior. This collection, however, contains a large number of specimens which preserve, in the matrix, the entire interior apparatus of crura, loop, spire, etc., and thus offer the means of obtaining a knowledge of these parts, which can usually only be acquired by careful and tedious manipulation upon favorably preserved specimens.

Mr. Greene has very kindly loaned to me a large number of illustrative specimens which I selected from his cabinet. These will be of much service and of great interest for the illus-

*Mr. Greene's collection of Crinoidea and Cystidea and of Cephalopoda from the Western Niagara is of wonderful beauty and magnitude.

trations of the volume. The New York Niagara Brachiopods are rarely in a condition to obtain a knowledge of the interior appendages or apparatus, and heretofore it has been only from the more solid or crystalline specimens from Waldron, Indiana, that we have been able to obtain a knowledge of the interior of the Niagara forms.

Besides this very extensive and magnificent collection of the Niagara group, Mr. Greene has also a large one, chiefly of Brachiopoda and Cephalopoda from the Hamilton group in its exposures near Milwaukee. Of these I have obtained specimens of Spirifera and of Lingula and Discina.

One of the most interesting and instructive features of Mr. Greene's great collection is the fact that it is strictly of local origin, and one is able to get a clear and comprehensive view of the Silurian fauna of this region without being embarrassed by the presence of species from distant localities.

Mr. E. E. Teller, of Milwaukee, has a very good collection of the Niagara group fossils of the country around Milwaukee. From this collection I obtained the loan of some Spirifers for study, and also some specimens preserving the internal spiral appendages of *Spirifera nobilis*, which I had not before seen. These will be illustrated in the forthcoming volume.

Mr. W. C. Egan, of Chicago, possesses a very good local collection of the Niagara fossils, including Chicago and its vicinity and the neighborhood of Milwaukee. His collection also embraces Lower Silurian, chiefly of the age of the Hudson River group, and also Devonian and Carboniferous species. I obtained from Mr. Egan the loan of a number of specimens which will add to our means of illustrating the volume on the Brachiopoda.

I should in this place make my acknowledgments to Miss Mary E. Holmes, of Rockford, Illinois, a graduate of the University of Michigan, and the author of an interesting and valuable paper on "The Morphology of the Carinæ on the Septa of the Rugose Corals."

Early in the spring I wrote to Miss Holmes of my plans regarding the work on the Brachiopoda, and she entered at once into the spirit of my scheme and wrote to many of her friends in behalf of the object. By this means I became acquainted with the names of many persons and institutions possessing local or general collections. Some of these I have visited and others remain to be examined in the future.

I am indebted to Rev. W. H. Barris, of Davenport, Iowa, for his willingness to assist me in this work, and having made an arrangement for the purchase of his collection am still hoping that it may be made useful in the preparation of this volume.

Prof. Calvin, of Iowa University, has been very liberal in loaning and otherwise furnishing specimens for study and illustration in the volume. Through his good will I have been enabled to give a figure of the typical specimen of *Stricklandinia castellana*, and of *Spirifera MacBridei*, as well as *Spirifera urbana*. I was also able to obtain from him, for illustration, the rare *Lingula Philomela* of Billings and other specimens. While he has sent to us many interesting species for comparison and use in the volume, and notably a large number of *Terebratula Calvini* for cutting or for use in any manner in forwarding the objects of this volume.

At Columbus, Ohio, Prof. Edward Orton, the State Geologist, placed the Brachiopoda of the State collection, as well as of his own private collection, at my disposal. I was able to select a considerable number of Trimerellæ, which afford excellent illustrations of the character of this fossil; also of Triplesia and other forms not available from New York localities.

This material has been brought to Albany and is held subject to the order of Prof. Orton, and will be returned to him on completion of the volume. This gentleman has promised, however, that, after the return of the specimens, he will furnish to the State Museum an illustrative collection of these forms from his own private cabinet.

I also visited and examined the collection of Mr. Moores, on Day street, Columbus, which contains much interesting material in several classes of fossils, but I found nothing of especial interest for my purposes. At a later date I have communicated a report in detail upon Mr. Moores' collection, which he has offered for sale at a moderate price.

I visited Granville, Ohio, and the collection of the Denison University. Prof. C. L. Herrick, of Denison University,* has sent down, for our use, some interesting forms of Brachiopoda from the Waverly sandstone of Licking county, Ohio. These are interesting for comparison with Chemung forms, and with certain specific forms described from this region many years since by the

* Now of the Cincinnati University.

writer, as well as for affording evidence of their structural development.

Appreciating the want of material from the Waverly group, not only for the study of their generic characters and significance, but for obtaining a knowledge of the geographical and geological distribution of species in this series, the writer engaged the services of Mr. Wm. F. Cooper, of Granville, on his personal account. Mr. Cooper has made a general collection of the fossils of that part of the country, without regard to special classes or orders, carefully marking the horizons from which they have been derived. This collection when carefully studied will afford much information upon the points above indicated.

Returning home in July, my time was devoted to the arrangement of the Brachiopoda in my possession, to selecting specimens for the draughtsman, and to the preparation of some plates of drawings for the lithographer;* during all the time continuing my correspondence with collectors in different parts of the country, Resuming my itinerary again early in October, I visited and examined a collection belonging to Mr. Edmond DeCew, of DeCewville, Ontario. This collection is chiefly from the Oriskany sandstone and corniferous limestone of the neighboring country. Since this collection was offered for sale at a very moderate price, I have examined and reported upon its contents somewhat in detail, giving a list of the species it contains, as will be seen by my communication already made to the committee upon the State Museum sometime recently.

At Delaware, Ohio, Prof. Nelson, of the Wesleyan University, very kindly gave me access to the collections of the university but since these were not particularly rich in Brachiopoda, I was able to select but a few specimens which were available for our object.

At Waynesville, I examined the collection of Mr. Israel Harris which is very abundant in species of the Hudson River (Cincinnati) group. I obtained from Mr. Harris the loan of some specimens of Trematis, which will aid in the illustration of the genus.

The collection of Mr. Harris is strictly local in its character and in this respect is far the most extensive of any one I have seen in Ohio. The collections of the Crustacea, Crinoidea and other

* Plates xxv, xxvi, xxvii and xxviii were placed in the hands of the lithographer during the months of August and September, 1888.

Echinodermata are very fine and very abundant. Among the curiosities of the collection is a single case containing 3,000 specimens of *Calymene senaria.*

At Cincinnati, Ohio, and Newport, Ky., through the aid of Mr. E. O. Ulrich and Mr. C. Schuchert, I examined the collections of fossils arranged in the Exposition Building which contained many interesting specimens. I also examined Mr. Schuchert's collection of Brachiopoda which is the best and most extensive one in this class of fossils which I have seen in the west. After having selected a large number of specimens which were desirable for our use, I made an arrangement with him to bring his entire collection to Albany, where it would be accessible during the progress of our work on volume VIII. I have also secured the services of Mr. Schuchert, who will give special attention to the selection and preparation of Brachiopoda in all the available collections.

At Lebanon, Ky., I obtained a few specimens of Brachiopoda, from Mr. W. T. Knott, with a promise of a larger collection in return for volumes of Palæontology, which have been sent to him.

I examined the public collections at Frankfort, Ky., and wish to acknowledge the courteous treatment received at the hands of Prof. Proctor and his Museum-assistant, Mr. Fischer. In behalf of the State Museum I have been promised, from the Geological Survey a collection of Brachiopoda illustrating the geological distribution of this class of fossils in the lower rocks of Kentucky.

The private collections of several individuals in Louisville contain much interesting material among the Devonian and Silurian Brachiopoda, but I have not been able to obtain specimens from any of these sources.

I have already communicated a special report upon the Nettelroth collection, which is very rich in Brachiopoda. It has been made the basis of study for the preparation of a volume upon the Palæontology of the State, and will therefore always have a special value as a scientific collection.

Mr. Victor W. Lyon, of Jeffersonville, Ind., has an exceedingly fine general collection of Silurian and Devonian fossils, among which are many Brachiopoda of great interest. Mr. Lyon has promised to send, either by loan or otherwise, important specimens for my use in the preparation of volume VIII.

At New Albany, Ind., I was able to obtain, by purchase from Mr. G. K. Greene, a collection of several hundred specimens of Brachiopoda, representing about twenty species and twelve genera of Silurian, Devonian and Carboniferous Brachiopoda. I also abtained from him the loan of a few interesting specimens showing internal structure.*

I visited Crawfordsville in the expectation of being able to secure a good collection of Carboniferous Brachiopoda, but the principal collector of this locality, Prof. Bassett, having died since my last visit to the place, and the localities for collecting being now monopolized for the purpose of procuring the Crinoidea, for which this place is so famous, I did not accomplish as much as I had hoped. I was able to purchase a few specimens from the collectors in the neighborhood, and these, together with those derived from a former collection made at this locality, will give a fair representation of the prevailing forms of this region for our Museum collections.

The Museum of the Wabash University contains a very rich collection of the Crinoidea and other fossils from this prolific locality. Prof. Coulter, of the University, afforded me free access to the fossils in the Museum, and also loaned to me for use in the volume several species of Carboniferous Spirifera which are in a better state of preservation than any specimens of the same species seen elsewhere.

I may here mention that Mr. Krout, the possessor of the remarkable form of Dictyospongidæ (*Cleodictya gloriosa*), has loaned to me the original specimen for use in the final preparation and publication of the memoir upon these sponges.

At Indianapolis I visited the State Geological Museum, which has been elaborately arranged in the new Capitol. The collection is an extensive one and contains a large amount of interesting material. I found, however, upon examining the Brachiopoda that I had already secured the use of similar material, and therefore made no application for the loan of specimens. Prof. Collett, under whose administration this collection was chiefly made, offered me every facility for its examination. The private collections in Indianapolis are not numerous or extensive.

At Delphi, Indiana, I visited the quarries in the Niagara lime-

* These have been recalled before we had an opportunity of making use of the material.

stone for the purpose of obtaining specimens of a large *Pentamerus*,* of which, up to this time, there have been no examples in the State Museum collections. These fossils occur in a magnesian limestone in the condition of casts of the interior, the shell having been dissolved and removed. The interior structure representing the hinge, crura and the spoon-shaped process are often beautifully preserved, and these parts, which are such an important generic feature are very conspicuously developed in this species, which can only be obtained in the condition just mentioned.

The locality is interesting from the abundance of individuals of this species. For an exposed thickness of eight or ten feet, in one quarry, these fossils are so abundant that no piece of limestone of six inches cube could be obtained without their presence, and they are literally crowded together in the limestone layers. The rock at this place has been quarried, and burned for lime, over an area of fully half an acre. The many tons of loose rock still remaining in the abandoned quarry, and the escarpment still exposed, show that the entire bed has been of the same character. At a point on the old Wabash canal, about a mile distant from the place just designated, there is an outcrop of apparently the same layer of limestone and equally filled with these Pentameri.

The stratum (or several strata the entire thickness of which remains unascertained) is nearly or quite at the upper limit of the Niagara group and in this neighborhood is apparently the uppermost layer. I am not aware that the species has been found in

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*This species was originally figured by Prof. E. Emmons in his Manual of Geology published in 1860, under the name *Pentamerus nobilis*. No description or reference to locality was ever published by him so far as I know. The fossil is widely distributed in the public and private collections of the country.

It is often labeled *Pentamerus* Knightii and I do not recollect to have anywhere seen it under the name of *P. nobilis*. This is undoubtedly the species described by Conrad under the name *Pentamerus laqueatus*. Proceedings Acad. Nat. Sci. Phila. Vol. 7, p. 441, as follows: "Ovate, large valve inflated with about twenty-eight angular ribs; mesial ridge but little prominent, with 5-6 ribs rather larger than the others. Smaller valve slightly ventricose, with a wide but shallow depression on each side; basal margin sinuous. Loc. Delphi, Ind. Mrs. Hill. The species resembles the P. Aylesfordii but is quite distinct."

This description antedates the figure of Prof. Emmons by five years, and although it may be regarded as meagre, the comparison with *P. Aylesfordii* is sufficient to distinguish it from any other American species. In its form and general character it more nearly approaches *P. Knightii* (=*P. Aylesfordii*) than any other American form, but it is quite distinct in many important characteristics. I shall endeavor to give some further information regarding its character, mode of occurrence and its relations to P. Knightii and other forms of the genus.

any other stratum of the group, or that it is known at any place outside of these quarries in the neighborhood of Delphi.

The gregarious (and at the same time isolated) habit of the Pentameri, in a few of their species, becomes an interesting fact when we observe the *P. oblongus*, in its early appearance in the Clinton group of New York, occupying, almost to the exclusion of any other fossils, a thin stratum on the Genesee river, and which can be traced for many miles along its outcrop in Wayne and Monroe counties, marked by the presence of this fossil in its entire or fragmentary condition.

The species is scarcely known in Orleans and Niagara counties, but again recurs in moderate numbers in the limestone of the Niagara age in Ontario, becoming more abundant in the western extension of the group. In Springfield, and perhaps elsewhere in Ohio, the species has acquired a remarkable development in size, and sometimes constitutes, almost by itself, an entire stratum of the Magnesian Niagara limestone. In Indiana, Illinois and Wisconsin, this species of Pentamerus acquires a most remarkable development in size and in numbers of individuals, often constituting beds of considerable thickness. It is usually elongate-ovoid, but is sometimes found having a length of from four to six inches, with a nearly equal width, while it may be symmetrically rounded or trilobate in form.

We note the recurrence of similar conditions of abundance attending the occurrence of *P. laqueatus* (=*P. nobilis*) which is remarkable in its limited geographical extent while *P. galeatus* occurs so abundantly in a limestone near the base of the Lower Helderberg that the stratum is known as the Pentamerus limestone. So far as known to the writer the Devonian forms of Pentamerus are rarely very abundant or especially characteristic of any bed or stratum in the system.*

At the Delphi quarries I had the volunteer assistance of Prof. Collett, of Indianapolis, and two students of the High School, where we spent two days of delightful work. To Messrs. A. B. and John A. Cortwright, W. O. McCain and Edward McCain, of the Delphi Lime Company, we were indebted for facilities, and for the providing of barrels and other material for

** Pentamerus papilionensis* of the Hamilton group is the most abundant form of Devonian age known to me in New York, while *Pentamerus costatus* of the same group in Michigan, is comparatively abundant at a single locality.

packing. The Museum is now in possession of two barrels and one large box of specimens of the *Pentamerus laqueatus*, in its usual mode of occurrence, collected at Delphi. This collection will furnish abundant material for selecting a very good series for illustration and for the arranged Museum collections, while there will still remain an abundant supply for distribution to schools and academies.

In company with Prof. Collett I visited the remarkable locality of Niagara fossils on Conn's creek, in the town of Waldron Indiana, which has been made famous through the publication of the Twenty-eighth Report on the New York State Museum of Natural History. Fortunately for the Museum collections and for our present purposes a large collection of fossils from this locality was secured many years since, when the ground was free for all collectors. The outcrop of the shale and limestone along the creek margin is now parceled out in small claims by the adjacent land-owners. The many hundreds of tons of refuse material, which after the selection of the fossils remain in heaps along the line of the creek, attest the extent of the working of the rock to secure its inclosed organic remains. Probably no locality in the United States, with the possible exception of Crawfordsville, has ever been worked, for the fossils alone, so extensively as the Niagara beds at Waldron.

An examination of the banks of the stream, swollen by recent rains, offered very little encouragement to the collector unless prepared with drills and hammers and abundant help, with plenty of time on his hands. The collections of the State Museum from this locality are very good and very abundant, and I was not able to add anything to the material already possessed for the illustration of the Brachiopoda of this locality.

The collectors of fossils at Waldron and its vicinity, Dr. R. R. Washburn, of Waldron, and Drs. J. W. and F. M. Howard, and Dr. Benjamin Jenkins, of St. Paul, have within the past years discovered a few new forms from this locality, and notably among them two or more species of Cystideans; but so far as observed no new forms among the Brachiopoda. It is not likely that new material will soon be obtained to supersede or seriously impair the value, for reference, of the paper published in the Twenty-eighth Museum Report.

At Muncie, Indiana, Dr. A. J. Phinney has an extensive and

very fine private collection of fossils illustrating the Silurian, Devonian and Carboniferous formations of the west. From this collection I borrowed a few specimens for comparison with species already in our collections.

On the fifth of November I left Indianapolis for Springfield, Illinois, for the purpose of visiting the State Museum of Natural History at the Capitol, where I made a careful examination of the public collections, especially of the Brachiopoda.

I also made a partial examination of the private collections of the late Prof. Worthen, which is in part arranged in cases of drawers and partly packed in boxes in a room adjacent to the State Museum. From the public collection I selected about 100 specimens, which I proposed to borrow for the purposes of comparison with those of our own Museum. Many of these were from the Carboniferous system, and I am especially desirous of comparing these, not only in their specific characters but with a view to a comparison of the nomenclature adopted in the publications of the Illinois survey.

At a later date the collections from the State Museum of Illinois were sent to Albany, and have served an important purpose in the comparison of species, and were very useful in the grouping of the various forms under the genus Spirifera.

In order to hasten the termination of my work of examining collections I employed Mr. C. Schuchert, of Cincinnati, to examine and report to me upon the character of a collection belonging to Mr. Vaupel of Cincinnati, and another belonging to Mr. Moores of Columbus, Ohio. The results of this examination embodied in a special report are already before the committee upon the State Museum.

In concluding my account of this itinerary, I wish to express my thanks to all the gentlemen named, who both in their public and private capacity, treated me most cordially and entered into the spirit of my object and purposes in obtaining a collection of the Brachiopoda for study, preliminary to a revision of the genera of that class of fossils.

I would more especially express my great obligations to Prof. John Collett, who has been untiring in his exertions to facilitate my work, and who has traveled with me for some hundreds of miles to visit some of the localities and collections in the State of Indiana. His presence was always cheering, his introductions

of myself to his friends were always cordial, and I received in return their generous confidence, and assistance. Through his intercession I have been able to travel over most of the railroads of Indiana upon passes generously granted by the managers of these roads, and to whom I especially wish to express my obligations.

While I have been engaged, as stated in the preceding pages, Mr. J. M. Clarke has been steadily occupied in the preparation of specimens for study and illustration, the superintendence of the drawings, and the forwarding of all the work preparatory to its final revision and preparation for the printer.

The development of the internal apparatus of various species has been carried on with the results indicated in the accompanying list of preparations. This is an extremely tedious work, requiring the exercise of much patience and mechanical skill, but the result offers a very important means of acquiring a correct understanding of many brachiopodous genera. Microscopic sections to show the structure of the shell have also been prepared, and we have now 445 of these, representing 104 species (see list). Many more are needed to insure the adequacy of conclusions based upon this part of the study. Of the original drawings necessary for the volume (as restricted), 125 have been prepared since May, and about 250 more remain to be done. Much of the material for these drawings is already in condition for the draughtsman. There remain ten plates to be engraved, and the accompanying table will show the condition of the lithography.

The preparation of the manuscript for the printer is also under way. The scope of the work will require the discussion of about 130 palæozoic genera and subgenera. The synonymy of these is, to a large degree, already prepared, the diagnosis of the genera prepared to the number of forty-five, and the generic discussions begun.*

*At the date of printing this report there is manuscript ready for the printer equal to 150 pages of text, which will be printed by the beginning of January, 1890.

THE GENERA OF THE PALÆOZOIC BRACHIOPODA.

Prepared by Mr. J. M. Clarke.

[This list will serve to indicate the subject-matter proposed for discussion in Palæontology of N. Y., Vol. VIII, but it is not intended to express acquiescence in the classification here provisionally adopted, or to indicate the validity of the generic terms. All non-binomial terms are omitted and also some of post-Linnean date too obscurely defined to be recognized.]

Order Inarticulata.

Family Lingulidæ.

Genus.

1. Lingula, Bruguière, 1792.
2. Dignomia, Hall, 1871.
3. Glossina, Phillips, 1848.
4. Lingulepis, Hall, 1863.
5. Lingulella, Salter, 1866.
6. Barroisella, gen. nov.
7. Lingulops, Hall, 1871.
8. Lingulasma, Ulrich, 1889.

Obolidæ.

9. Obolus, Eichwald, 1829.
10. Obolella, Billings, 1861.
11. Dicellomus, Hall, 1871.
12. Leptobolus, Hall, 1872.
13. Schmidtia, Volborth, 1869.
14. Neobolus, Waagen, 1885.
15. Mickwitzia, Schmidt, 1888.
16. Monobolina, Salter, 1865.
17. Aulonotreta, Kutorga, 1848.
18. Acritis, Volborth, 1869.
19. Elkania, Ford, 1886.
20. Spondylobolus, McCoy, 1852.
21. Paterula, Barrande, 1879.
22. Schizobolus, Ulrich, 1886.
23. Discinolepis, Waagen, 1885.

Siphonotretidæ.

24. [?] Kutorgina, Billings, 1861.
25. Schizopholis, Waagen, 1883.
26. Volborthia, Möller, 1874.
27. Iphidea, Billings, 1874.
27. Geinitzia, gen. nov.
29. Acrotreta, Kutorga, 1848.
30. Acrothele, Linnarsson, 1876.
31. Linnarssonia, Walcott, 1885.
32. Discinopsis, gen. nov. Matthew.
33. Mesotreta, Kutorga. 1848.
34. Siphonotreta, Verneuil, 1845.
35. Schizambon, Walcott, 1884.
36. Keyserlingia, Pander, 1861.
37. Helmersenia, Pander, 1861.

Discinidæ.

38. (?) Discinisca, Dall, 1871.
39. Orbiculoidea, D'Orbigny, 1847.
40. Schizotreta, Kutorga, 1848.
41. Lindstromella, gen. nov.
42. Œhlertella gen. nov.
43. Rœmerella, gen. nov.
44. Trematis, Sharpe, 1847.
45. Orbicella, D'Orbigny, 1847.
46. Schizocrania, Hall and Whitfield, 1875.

TRIMERELLIDÆ.

47. Trimerella, Billings, 1862.
48. Monomerella, Billings, 1871.
49. Rhinobolus, Hall, 1871.
50. Dinobolus, Hall, 1871.
51. Conradia, Hall (MS.), 1871.
52. Gotlandia, Dall, 1870.
53. Obolellina, Billings, 1871.
54. Davidsonella, Waagen, 1885.

CRANIADÆ.

55. Crania, Retzius, 1781.
56. Orbicula, Cuvier, 1798.
57. Criopus, Gray, 1821.
58. Craniella, Œhlert, 1888.
59. Cardinocrania, Waagen, 1885.
60. Pseudocrania, McCoy, 1851.
61. Palæocrania (Eichwald), Quenstedt, 1871.
62. Choniopora, Schauroth, 1854.
63. Craniops, Hall, 1859.
64. Pholidops, Hall, 1860.

Order Articulata.

FAMILY ORTHIDÆ.

65. Orthis, Dalman, 1828.
66. Bilobites, Linnæus, 1775.
67. Dicœlosia, King, 1850.
68. Platystrophia, King, 1850.
69. Schizophoria, King, 1850.
70. Orthambonites, Pander, 1830.
71. Orthostrophia, Hall, 1882.
72. Scenidium, Hall, 1860.
73. Mystrophora, Kayser, 1871.
74. Enteletes, Fischer, 1837.
75. Syntrielasma, Meek, 1865.
76. Orthonomæa, Hall, 1858.

STROPHOMENIDÆ.

77. Strophomena, Rafinesque, 1820.
78. Strophodonta, Hall, 1852.
79. Leptagonia, McCoy, 1844.
80. Plectambonites, Pander, 1830.
81. Strophonella, Hall, 1879.
82. Leptæna, Dalman, 1828.
83. Davidsonia, Bouchard, 1849.
84. Orthisina, D'Orbigny, 1847.
85. Streptorhynchus, King, 1850.
86. Orthothetes, Fischer, 1829.
87. Gonambonites, Pander, 1830.
88. Hemipronites, Pander, 1830.
89. Klitambonites, Pander, 1830.
90. Pronites, Pander, 1830.
91. Hipparionyx, Vanuxem, 1842.
92. Meekella, White and St. John, 1868.
93. Triplesia, Hall, 1859.
94. Dicraniscus, Meek, 1872.
95. Streptis, Davidson, 1881.
96. Derbyia, Waagen, 1884.
97. Waagenia, gen. nov.
98. [?] Tropidoleptus, Hall, 1857.
99. [?] Vitulina, Hall, 1857.

PRODUCTIDÆ.

100. Chonetes, Fischer, 1837.
101. Aulacorhynchus, Dittmar, 1872.
102. Isogramma, Meek and Worthen, 1873.
103. Strophalosia, King, 1844.
104. Leptænalosia, King, 1845.
105. Orthothrix, Geinitz, 1847.
106. Chonetella, Waagen, 1884.
107. Daviesiella, Waagen, 1884.
108. Aulosteges, Helmersen, 1847.
109. Productus, Sowerby, 1812.
110. Productella, Hall, 1867.
111. Marginifera, Waagen, 1884.

PORAMBONITIDÆ.

112. Porambonites, Pander, 1830.
113. Isorhynchus, King, 1850.

RICHTHOFENIDÆ.

114. Richthofenia, Kayser, 1883.

SPIRIFERIDÆ.

115. Spirifera, Sowerby, 1815.
116. Trigonotreta, Konig, 1825.
117. Brachythyris, McCoy, 1844.
118. Choristites, Fischer, 1825.
119. Martinia, McCoy, 1844.
120. Reticularia, McCoy, 1844.
121. Martiniopsis, Waagen, 1883.
122. Mimulus, Barrande, 1879.
123. Cyrtia, Dalman, 1828.
124. Ambocœlia, Hall, 1860.
125. Mentzelea, Quenstedt, 1871.
126. Spiriferina, D'Orbigny, 1847.
127. Cyrtina, Davidson, 1858.
128. Syringothyris, Winchell, 1863.

ATHYRIDÆ.

129. Athyris, McCoy, 1844.
130. Spirigera, D'Orbigny, 1847.
131. Euthyris, Quenstedt, 1871.
132. Actinoconchus, McCoy, 1844.
133. Seminula, McCoy, 1844.
134. Cleiothyris, King, 1850.
135. Spirigerella, Waagen, 1883.
136. Kayseria, Davidson, 1882.
137. Merista, Suess, 1851.
138. Camarium, Hall, 1859.
139. Meristella, Hall, 1859.
140. Meristina, Hall, 1867.
141. Charionella, Billings, 1861.
142. Whitfieldia, Davidson, 1882.
143. Pentagonia, Cozzens, 1846.
144. Goniocœlia, Hall, 1861.
145. Bifida, Davidson, 1882.

NUCLEOSPIRIDÆ.

146. Nucleospira, Hall, 1858.
147. Schnuria, gen. nov.
148. Retzia, King, 1850.
149. Rhynchospira, Hall, 1859.
150. Trematospira, Hall, 1857.
151. Acambona, White, 1862.
152. Eumetria, Hall, 1864.
153. Uncites, De France, 1825.
154. Uncinella, Waagen, 1883.
155. Dayia, Davidson, 1882.
156. Hindella, Davidson, 1882.

ATRYPIDÆ = ZYGOSPIRIDÆ.

157. Atrypa, Dalman, 1828.
158. Spirigerina, D'Orbigny, 1847.
159. Zygospira, Hall, 1862.
160. Cœlospira, Hall, 1863.
161. Glassia, Davidson, 1882.
162. Anazyga, Davidson, 1882.
163. Grünewaldtia, Tschernyschew, 1885.

KONINCKINIDÆ.

164. Anoplotheca, Sandberger, 1857.

RHYNCHONELLIDÆ.

165. Rhynchonella, Fischer, 1809.
166. Cyclothyris, McCoy, 1884.
167. Hypothyris, Phillips, 1841.
168. Wilsonia, Quenstedt, 1871.
169. Uncinulus, Bayle.
170. Terebratuloidea, Waagen, 1883.
171. Rhynchotrema, Hall, 1860.
172. Rhynchopora, King, 1856.
173. Eatonia, Hall, 1857.
174. Stenocisma, Conrad, 1839.
175. Leiorhynchus, Hall, 1860.
176. Karpinskia, Tschernyschew, 1885.

PENTAMERIDÆ.

177. Pentamerus, Sowerby, 1813.
178. Zdimir, Barrande, 1881.
179. Sieberella,
180. Gypidia, Dalman, 1828.
181. Gypidula, Hall, 1857.
182. Pentamerella, Hall, 1867.
183. Camarophoria, King, 1846.
184. Anastrophia, Hall, 1867.
185. Brachymerus, Shaler, 1865.
186. Camarella, Billings, 1859.
187. Stricklandinia, Billings, 1863.
188. Amphigenia, Hall, 1867.
189. Clorinda, Barrande, 1879.

Family ——?

190. Eichwaldia, Billings, 1858.
191. Dictyonella, Hall (M.S.) 1867.

Thecididæ.

192. Lyttonia, Waagen, 1883.
193. Oldhamina, Waagen, 1883.

Stringocephalidæ.

194. Stringocephalus, Sandberger, 1842.

Terebratulidæ.

195. Terebratula, Müller, 1776.
196. Dielasma, King, 1859.
197. Epithyris, King, 1850.
198. Waldheimia, King, 1850.
199. Cryptacanthia, White and St. John, 1868.
200. Eudesia, King, 1850.
201. Hemiptychina, Waagen, 1883.
202. Centronella, Billings, 1859.
203. Cryptonella, Hall, 1861.
204. Rensselæria, Hall, 1859.
205. Meganteris, Suess, 1856,= Megalanteris, Barrois, 1889.
206. [?] Leptocœlia, Hall, 1857.
207. Notothyris, Waagen, 1882.

The [?] before the name indicates a doubt as to the family relations of the genus; the (?) a doubt as to whether the genus occurs in rocks of Palæozoic age.

LIST OF MICROSCOPIC SECTIONS OF BRACHIOPODA.

December 1, 1888.

	Number of sections.
Lingula punctata	2
densa	2
Lingulepis pinniformis	2
Discina Conradi	4
media	6
Pholidops Hamiltoniæ	2
Crania Hamiltoniæ	4
Orthis multistriata	3
Iowensis	8
Vanuxemi	18
hybrida	13
Penelope	5
subquadrata	2
elegantula	11
flabella	6
Clytie	4
Livia	4
tricenaria	3
biforata	4
lenticularis	3
testudinaria	15
perveta	5
impressa	2
emacerata	3
occidentalis	17
oblata	5
Orthis sinuata	4
insculpta	3
plicatella	1
Tulliensis	7
borealis	2
pectinella	2
Orthostrophia strophomenoides	1
Strophomena alternata	9
rhomboidalis	18
Strophonella semifasciata	1
reversa	1
Strophodonta arcuata	4
ampla	4
perplana	15
crebristriata	5
demissa	15
Junia	3
nacrea	4
concava	15
striata	3
Leptæna sericea	4
Streptorhynchus planoconvexum	2
crenistria	1
subplanum	2
hipparionyx	1

	Number of sections.
Streptorhynchus planumbonum	2
tenue	2
sp.	3
Chonetes deflecta	4
coronata	15
scitula	4
mucronata	9
Productus subalatus	4
Spirifera Conradana	1
mucronata	6
zic-zac	1
granulifera	4
pennata	8
cycloptera	1
lævis	3
medialis	4
Hungerfordi	3
sculptilis	2
Spiriferina spinosa	1
Athyris Roissyi	1
congesta	2
spiriferoides	9
Atrypa reticularis	7
aspera	1
spinosa	3
Cyrtina Hamiltonensis	7
Syringothyris textus	6
Whitfieldia Maria	4

	Number of sections.
Meristella nasuta	4
Ambocœlia umbonata	5
Zygospira modesta	1
Nucleospira pisiformis	2
concinna	4
Leptocoelia imbricata	1
Trematospira camura	2
nobilis	1
hirsuta	3
Retzia evax	3
Rhynchonella capax	2
Sappho	4
Stricklandi	2
Leiorhynchus multicosta	2
Eatonia medialis	4
Anastrophia internascens	1
Rhynchotreta cuneata	3
Pentamerus pseudogaleatus	6
Pentamerella arata	1
papilionensis	2
Stricklandinia	1
Rensselaeria ovalis	2
Amphigenia elongata	2
Tropidoleptus carinatus	7
Cryptonella rectirostra	2
Total	464

LIST OF PREPARATIONS FOR VOL. VIII, SHOWING INTERNAL APPARATUS, CRURA, SPIRALS, LOOPS, SEPTA, ETC.

December 1, 1888.

Spirifera granulifera, Hall.
mucronata, Conrad.
Conradana, Miller.
pennata, Owen,
Whitneyi, Hall.
radiata, Sowerby.
Orestes, Hall.
Hungerfordi, Hall.
Macbridii, Calvin.
arenosa, Conrad.
pseudolineata, Hall.
inaequicostata, Owen.
subumbona, Hall.
perplexa, McChesney.
medialis, Hall.

Spirifera crispa var. simplex, Hall.
gregaria, Hall.
Marcyi, Hall.
Eudora, Hall.
euruteines, Owen.
cyrtiniformis, Hall.
aspera, Hall.
Syringothyris textus, Hall.
typa, Winchell.
Cyrtina Hamiltonensis, Hall.
umbonata, Hall.
rostrata, Hall.
acutirostris, Shumard.
Ambocoelia umbonata, Conrad.
Meristella Haskinsi, Hall.

Meristella Barrisi, Hall!
lata, Hall.
lævis, Vanuxem.
nasuta, Conrad.
naviformis, Hall.
Pentagonia unisulcata, Conrad.
Meristina nitida, Hall.
rectirostra, Hall.
Whitfieldia Maria, Hall.
Nucleospira pisiformis, Hall.
concinna, Hall.
ventricosa, Hall.
Schuuria n. gen.
Trematospira hirsuta, Hall.
multistriata, Hall.
camura, Hall.
Eumetria vera, Hall.
Retzia evax, Hall.
Athyris subtilita, Hall.
Athyris vittata, Hall.
spiriferoides, Eaton.
trinuclea, Hall.
congesta, Conrad.
sp. ?
Atrypa reticularis, Linnæus.
spinosa, Hall.
Zygospira modesta, Say.
Rensselaeria Suessana, Hall.
Pentamerus galeatus, Dalman.
Nysius, Hall.
Rhynchotreta cuneata, Dalman.
Eichwaldia reticulata, Hall.
Enteletes hemiplicata, Hall.
Triplesia [? ?] lateralis, Whitfield.
Cryptonella planirostra, Hall.
[? ?] Calvini, Hall.
Terebratula [?] Romingeri, Hall.
[?] sp.

LIST OF PLATES OF BRACHIOPODA FOR PALÆONTOLOGY OF N. Y., VOL. VIII, SHOWING THE CONDITION OF THE WORK.

DECEMBER 1, 1888.

I.	Lingula	In hands of Lithographer.
II.	Lingulella, Lingulepis, etc.*	Not made up.
III.	Obolidæ*	Not made up.
IV.	Siphonotretidæ, Discinidæ, Craniadæ*	Not made up.
IVA.	Trimerellidæ	Not made up.
AV.	Orthidæ	Engraved.
V.	Orthidæ	Engraved.
VI.	Orthidæ	Engraved.
VII.	Orthidæ	Engraved.
VIII.	Strophomenidæ	Engraved.
IX.	Strophomenidæ	Engraved.
X.	Strophomenidæ	Engraved.
XI.	Strophomenidæ	Engraved.
XIA.	Strophomenidæ	Engraved.
XII.	Strophomenidæ	Engraved.
XIII.	Strophomenidæ	Engraved.
XIV.	Strophomenidæ	Engraved.
XV.	Strophomenidæ	Engraved.
XVI.	Productidæ	Engraved.
XVII.	Productidæ	Engraved.
XVIII.	Productidæ	Engraved.

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* At the date of printing this Report the first thirteen plates of the volume have been made up; plates I and II have been lithographed and printed and plates III, IV, IVA and IVB have been lithographed and are ready for printing.

XIX.	Productidæ	Engraved.
XX.	?	Not made up.
XXI.	Spiriferidæ	Engraved.
XXII.	Spiriferidæ	Engraved.
XXIII.	Spiriferidæ	Engraved.
XXIV.	Spiriferidæ	Engraved.
XXV.	Spiriferidæ	Engraved.
XXVI.	Spiriferidæ	Engraved.
XXVII.	Spiriferidæ	Engraved.
XXVIII.	Spiriferidæ	Engraved.
XXIX.	Spiriferidæ	Made up.
XXX.	Spiriferidæ	Engraved.
XXXI.	Spiriferidæ	Engraved.
XXXII.	Spiriferidæ	Engraved.
XXXIII.	Spiriferidæ	Engraved.
XXXIV.	Spiriferidæ	Engraved.
XXXV.	Spiriferidæ	Engraved.
XXXVI.	Spiriferidæ	Engraved.
XXXVII.	Atrypidæ (drawings in part already made)	Not made up.
XXXVIII.	Atrypidæ (drawings in part already made)	Not made up.
XXXIX.	Athyridæ (drawings in part already made)	Not made up.
XL.	Athyridæ (drawings in part already made)	Not made up.

A large number of drawings for plates following XL have been made.

A List of the Fossils Occurring in the Oriskany Sandstone of Maryland, New York and Ontario.

Prepared by Mr. Charles Schuchert, from an examination and arrangement of my own collections and the published descriptions of species from this Geological horizon.

In connection with my work upon the Brachiopoda during the past year it became necessary for me to overhaul and arrange an extensive store of Palæozoic fossils which had accumulated on my hands from purchase and exchange during the past fourteen years. Among these were large collections from the Oriskany Sandstone of Maryland and of Ontario, Canada; these being the two extreme points from which I have obtained any considerable number of fossils from this formation.

The relations of the Oriskany Sandstone to the Silurian below and the recognized Devonian above have been subject to discussion from time to time during the past years.

In Volume III, Palæontology of New York, I had already introduced the subject of the geological range of certain species of the Oriskany Sandstone and the relations of this formation to the Lower Helderberg Rocks of Silurian age and those of the succeeding Devonian period.

At that time (1859) our collections had not reached the extent they have since attained, and therefore our comparisons and inferences were very imperfect and incomplete.

I have long intended to prepare and present to the public such a catalogue as the following, but my duties, and the pressure of other and more immediately important work upon my assistants, has always prevented the accomplishment of this object up to the present time. The arrangement of this list will show the geological range of each species thus far know in the Oriskany Sandstone, and the legitimate conclusions can be readily inferred.*

*The varying physical conditions which have prevailed during the deposition of this sandstone over the large area indicated by this extensive outcrop are worthy of more careful consideration that my time and the present circumstances will permit.

The work of preparing and arranging the large collections referred to above has been done under my direction by Mr. Charles Schuchert and he has reported to me this catalogue with the following remarks:

In preparing and arranging the large quantity of material from this formation, collected at Cumberland, Maryland, Albany and Schoharie counties, New York, and in the neighborhood of Cayuga, Ontario, in the collection of Professor James Hall, he suggested that it would be a matter of interest to determine the number of species known in this formation in our present state of knowledge, and how many species passed from the Lower Helderberg into the Oriskany Sandstone, and from the latter into the Upper Helderberg.

The following list contains all the species observed in the above collections as well as those described in the different volumes of the New York Geological Survey and the Geology of Canada, 1863.

There are 140 species enumerated as occurring in the Oriskany Sandstone, of which 17 are common to the three widely separated localities. Fourteen of these belong to the Brachiopoda, which are by far the most numerous in specimens and species, 72 being known. The Gastropoda are quite abundant at Cumberland, Md., while in New York and Ontario they appear in greatly reduced numbers.

Fourteen species pass from the Lower Helderberg into the Oriskany Sandstone, distributed as follows: Nine in Maryland, two in New York, and eight in Canada West. From the Oriskany Sandstone, 54 species pass into the Upper Helderberg. Of these 52 pass from the Oriskany of Ontario, Canada West into Upper Helderberg, while seven only are known to pass upward in New York and the same number in Maryland.

At Cumberland 63 species have been noticed of which 21 are common to this and the New York localities. Forty-six are noticed as occurring in New York, and of these 21 are also found at Cayuga, Ontario, while at the last named locality 76 species are recorded, 19 of which also occur at Cumberland.

	Also occurring in the Lower Helderberg.	Oriskany Fauna.			Also occurring in the Corniferous Limestone.
		Cumberland, Maryland.	New York.	Cayuga, Canada West.	
Favosites conicus, Hall	*	*		*	*
Favosites Gothlandicus, Lamarck*	*			*	*
Favosites hemisphericus, Troost			*	*	*
Favosites tuberosus, Rominger				*	*
Favosites turbinatus, Billings*				*	*
Phillipsastrea gigas, Owen				*	*
Michelinia convexa, D'Orbigny				*	*
Michelinia stylopora??				*	
Aulacophyllum sp. undet				*	*
Heliophyllum exiguum, Billings				*	*
Chonophyllum magnificum, Billings				*	*
Cystiphyllum Americanum, Edwards and Haime				*	*
Cystiphyllum sulcatum, Billings*				*	*
Zaphrentis gigantea, Rafinesque				*	*
Zaphrentis mammifera, ?				*	*
Zaphrentis prolifica, Billings				*	*
Zaphrentis torta, Hall?				*	*
Zaphrentis sp				*	*
Alveolites sp. undet				*	
Polypora hexagonalis, Hall				*	*
Fistulipora sp. undet				*	*
Homocrinus proboscidalis, Hall		*			
Mariacrinus Andrewsi, Hall		*			
Mariacrinus sculptus, Hall		*			
Mariacrinus spinulosus, Hall		*			
Mariacrinus striatus, Hall		*			
Edriocrinus sacculus, Hall		*			
Very large undet. species of Crinoid		*			
Anomalocystites disparilis, Hall		*			
Pholidops arenaria, Hall			*		
Pholidops terminalis, Hall		*			
Discina ampla, Hall†			*	*	*
Chonetes? complanata, Hall		*	*	*	
Chonetes hemispherica, Hall				*	*
Chonetes allied to C. mucronata				*	*
Orthis Cumberlandia, Hall		*			
Orthis livia, Billings				*	*
Orthis musculosa, Hall		*	*	*	
Orthis planoconvexa, Hall	*	*			
Leptæna? nucleata, Hall			*		
Strophomena rhomboidalis, Wilckens	*			*	*
Strophomena rhomboidalis, var. ventricosa, Hall		*	*		
Strophodonta demissa, Conrad				*	*
Strophodonta hemisphærica, Hall				*	*
Strophodonta inaequistriata, Conrad*				*	*
Strophodonta intermedia, Hall		*			
Strophodonta Lincklæni, Hall			*		
Strophodonta magnifica, Hall		*	*	*	
Strophodonta magniventra, Hall		*	*		
Strophodonta perplana, Conrad				*	*
Strophodonta vascularia, Hall			*	*	
Strophonella Headleyana, Hall	*	*			
Strophonella ampla, Hall ‡				*	*
Streptorhynchus (Hipparionyx) proximum, Vanuxem (Orthis hipparionyx Hall)		*	*	*	*
Streptorhynchus Pandora, Billings				*	*
Rhynchonella Barrandi, Hall		*	*		
Rhynchonella Billingsi, Hall				*	*
Rhynchonella Fitchiana, Hall			*		
Rhynchonella multistriata, Hall			*		
Rhynchonella oblata, Hall			*		
Rhynchonella principalis, Hall			*		

* Species marked by an * are given on the authority of Mr. Billings.

† This species was described in Vol. 3 as *D. grandis*, Hall. The name being preoccupied by Vanuxem, was changed to *D. ampla*, Hall, in Pal. N. Y. Vol. 4, p. 17.

‡ *S. ampla*, has been regarded as a synonym of *S. Headleyana*. This may be proved by farther comparisons; in the meantime they are here separately recorded.

	Also occurring in the Lower Helderberg.	Oriskany Fauna. Cumberland, Maryland.	Oriskany Fauna. New York.	Oriskany Fauna. Cayuga, Canada West.	Also occurring in the Corniferous Limestone.
Rhynchonolla Ramsayi, Hall		*			
Rhynchonella septata, Hall			*		
Rhynchonella speciosa, Hall		*			
Rhynchonella n. sp		*			
Eatonia peculiaris, Conrad	*	*	*	*	
Eatonia pumila, Hall			*		
Eatonia sinuata, Hall		*			
Eatonia Whitfieldi, Hall		*			
Pentamerella arata, Conrad				*	*
Pentamerella (of the character of Gypidula occidentalis)				*	
Amphigenia elongata, Vanuxem*				*	*
Spirifera arenosa, Conrad†		*	*	*	*
Spirifera arrecta, Hall		*	*	*	
Spirifera Cumberlandiæ, Hall		*			
Spirifera fimbriata, Conrad			*		*
Spirifera intermedia, Hall		*			
Spirifera pyxidata, Hall		*	*	*	*
Spirifera submucronata, Hall		*			
Spirifera tribulis, Hall		*			
Cyrtina rostrata, Hall		*	*	*	
Rhynchospira rectirostra, Hall		*			
Nucleospira elegans, Hall	*			*	
Cœlospira dichotoma, Hall		*	*	*	
Leptocœlia fimbriata		*			
Leptocœlia flabellites, Conrad		*	*	*	
Atrypa reticularis, Linnæus	*			*	*
Meristella scitula, Hall				*	*
Meristella lata, Hall		*	*	*	
Meristella lenta, Hall				*	*
Meristella unisulcata, Conrad			*		*
Meristella cfr. princeps, Hall	*	*			
Meristella sp. undet		*			
Meristella n. sp		*			
Rensselæria Cumberlandiæ, Hall		*			
Rensselæria intermedia, Hall		*			
Rensselæria Marylandica, Hall		*			
Rensselæria ovalis, Hall		?*	*	*	*
Rensselæria ovoides, Hall		*	*	*	
Rensselæria Suessiana, Hall		*			
Centronella glansfagea, Hall				*	*
Centronella tumida, Billings				*	*
Tentaculites arenosus, Hall			*		
Conularia lata, Hall			*		
Platyceras carinatum, Hall				*	*
Platyceras concavum, Hall				*	*
Platyceras callosum, Hall		*			
Platyceras dentalium, Hall				*	*
Platyceras Gebhardi, Conrad	*	*		?	
Platyceras magnificum, Hall		*			
Platyceras nodosum, Conrad			*	*	
Platyceras patulum, Hall		*			
Platyceras reflexum, Hall		*			
Platyceras subnodosum, Hall			*		
Platyceras tortuosum, Hall‡			*		
Platyceras ventricosum, Conrad	*	*			
Platystoma ventricosa, Conrad	*	*	*	*	
Strophostylus Andrewsi, Hall		*			
Strophostylus expansus, Hall			*		
Strophostylus Matheri, Hall		*			
Strophostylus transversus, Hall		*		?*	
Cyrtolites ? expansus, Hall		*	*	*	
Pleurotomaria sp. undet				*	
Loxonema subattenuatum ?, Hall				*	*
Orthoceras arenosum, Hall			*		

* Species marked with an * are given on the authority of Mr. Billings.

† *S. unica* Hall, of the Corniferous limestone synonymous with *S. arenosa* Conrad.

‡ P. *concavum*, P. *dentalium* and P. *tortuosum* are closely allied forms.

	Also occurring in the Lower Helderberg.	Oriskany Fauna.			Also occurring in the Corniferous Limestone.
		Cumberland, Maryland.	New York.	Cayuga, Canada West.	
Avicula Gebhardi, Conrad			*		
Avicula recticosta, Hall			*		
Avicula textilis var. arenaria, Hall		*	*	*	
Megambonia bellistriata, Hall			*		
Megambonia lamellosa, Hall		*	*		
Cypricardinia sp. undet				*	
Cypricardinia planulata, Conrad ?				*	
Conocardium trigonale				*	*
Dalmanites (Chasmops) anchiops, Green				*	*
D. (Hausmannia) pleuroptyx, Green	*			*	*
Homalonotus Vanuxemi, Hall	*	*			
Homalontous major, Whitfield			*		
Phacops cristata, Hall				*	*
Proetus crassimarginatus, Hall				*	*
Calymene platys, Green†				*	*
Fish spine				*	

* Species marked by an * are given on the authority of Mr. Billings.

† Mr. Billings mentions *C. Blumenbachi* Brongniart in the Oriskany of Canada West, but in all probability the species is the *C. platys*, Green.

In Volumes 3 and 6, Pal. N. Y., there have been described from the Lower Helderberg group, 371 species, distributed among the several classes as follows :

	Species.
Crinoidea	18
Cystoidea	5
Pteropoda	4
Brachiopoda	105
Lamellibranchiata	35
Gastropoda	67
Cephalopoda	11
Annelida	1
Crustacea	24
Corals and Bryozoa	101
	371

Of these, fourteen, or three and three-quarters per cent are known to pass upward into the Oriskany sandstone.

In the preceding report I have called attention to the unfinished work upon the Bryozoa which have formed the basis of of Volume VI and subsequently published papers, and to the large collection of specimens still remaining unlabeled, and consequently

unavailable for any use whatever; and also to the very extensive accumulation of corals remaining in the same condition.

In order to a better appreciation of the work already done in Volume VII, and that now in progress for Volume VIII, this report is accompanied by:

1. A synoptical table of the contents of Vol. VII, and of Volume V, pt. ii, supplement.

2. A list of the type specimens of the Devonian Crustacea in possession of the State Museum.

3. A statement regarding the work done and collections made for the illustration of Volume VIII, Palæontology of New York.

4. A classified list of the Palæozoic genera of Brachiopoda.

5. A list of the microscopic sections of Brachiopoda.

6. A list of the preparation of the loops, crura and spires, etc.

7. A list of the plates of the Brachiopoda showing the present condition as regards the drawing and lithography.

8. A list of fossils known to occur in the Oriskany sandstone of Maryland, New York and Ontario, Canada; with an indication of their geological range.

In addition to the above, and following the report proper, I have communicated

9. A paper entitled Descriptions and Illustrations of the FENESTELLIDAE and other Bryozoa, continued from the REPORT of the STATE GEOLOGIST for the year 1887, illustrated by plates xvi, xvii, xviii and xix.

10. A paper on the Genus Bronteus in the Chemung rocks of New York, and another giving

11. A list of the species constituting the known fauna and flora of the Marcellus epoch in the State of New York, by J. M. Clarke; also

12. A paper on the HERCYNIAN QUESTION, being a brief review of its development and present status, with some remarks upon its relations to the current classification of American Palæozoic Faunas, by J. M. Clarke.

13. A paper on a locality of flint implements in Wyoming county, N. Y., with diagram, by Prof. I. P. Bishop, of the State Normal and Training School, at Buffalo, N. Y.

14. A catalogue of the specimens forming the representation of the Taconic System, as originally arranged by Prof. E. Emmons in the State Cabinet of Natural History in 1843 and published in

the first report upon that institution by the Regents of the University in 1848.

15. For the convenience of future reference I have appended a list of the plates, the number of drawings, the name of the draughtsman and lithographer, etc., for Volume V, parts i and ii, Volume VI and Volume VII.

16. Also, a catalogue of the locality numbers, marking the specimens collected in different parts of New York and other States for use in the preparation of the volumes on the Palæontology of New York since 1856, with name of collector, etc.

All which is respectfully submitted.

JAMES HALL,
State Geologist.

DESCRIPTIONS AND ILLUSTRATIONS OF THE FENESTELLIDÆ AND OTHER BRYOZOA, CONTINUED FROM THE REPORT OF THE STATE GEOLOGIST, FOR THE YEAR 1887.

[Plates xvi, xvii, xviii and xix.]

This paper will not be printed in the present report on account of the impossibility of obtaining proper illustrations of these subjects by the recently adopted methods.

The Genus Bronteus in the Chemung Rocks of New York.

Communicated to JAMES HALL, State Geologist, by J. M. CLARKE.

Trilobitic remains are of so rare occurrence in the Chemung faunas, that the discovery of a new form is attended with an unusual degree of interest. Hitherto we have known but two, possibly three, species of trilobites from these rocks; *Cyphaspis lævis*, Hall, of which, it is understood, but a single specimen has been seen (*Vide* Palæontology of N. Y., Vol. VII, p. 150, pl. xii, fig. 29), *Phacops nupera*, Hall, a species of doubtful value, the original specimen being imperfect in those particulars which, if retained, would serve to prove or disprove its specific validity. All positive evidence furnished by the original, points to the identity of *Ph. nupera* with *Ph. rana*, Green. The writer has been informed by Mr. H. S. Williams, of the occurrence of undoubted *Phacops rana* in certain horizons of the Chemung group, a fact not generally known at the time of the preparation of Volume VII of the Palæontology of New York.

To these meager evidences of the trilobite fauna of the upper Devonian is to be added the form under consideration, an incomplete pygidium of a species of *Bronteus*, from the beds of the Lower Chemung in the town of Prattsburgh, Steuben county. In the American Devonian this genus has proved exceedingly rare; indeed, a single pygidium, and a fragment of the epistomal doublure from the Tully limestone in Onondaga county, have furnished the sum of our knowledge of its post-Silurian existence in this country. This Tully

FIG. 1. BRONTEUS SENESCENS (enlarged to two diameters).

species, described in Volume VII of the Palæontology of New York as *Bronteus tullius*, Hall (pp. 12, 13, pl. viiia, figs. 34-36), is characterized by its broad, flattened pygidial annulations, which become obsolete only near the margin, the median rib being simple, not bifurcated as in many species occurring in the Upper Silurian and lowest Devonian faunas, and also by the presence of a row of minute spinules about the postero-lateral margin, which demonstrate the relations of the species to the characteristic Devonian subgenus *Thysanopeltis*. In the Chemung species (which may be designated *Bronteus senescens*), we are presented with considerably greater dimensions, the original width of the pygidium being about 40mm. Unfortunately, no portion of the postero-lateral margin has been retained, and its relations to *Thysanopeltis* can not be ascertained. The *axis* is short and relatively wide. Of the fifteen annulations, the median is quite narrow and appears to be simple, though its lower portion is lost. The lateral annulations vary greatly in size; those adjacent to the median rib are of about the same width, *i. e.*, very narrow, widening posteriorly, while the next three pairs are broad, somewhat flattened, and widen very slightly as they extend backward. The succeeding three pairs originate in acute apices at the axis, and widen very rapidly, the width of any one of them, at the obsolescence of the sulci, equaling or exceeding that of any two of the others. The sulci are narrow and smooth, soon becoming obsolete and leaving the marginal portion of the shield relatively broad. The rapid obsolescence of the ribs indicates that the pygidium must have been comparatively short, and, if the outline given it in the accompanying figure be approximately correct, it indicates a peculiar form of pygidium, rarely met with in the genus. (Conf. *Bronteus Gervillei*, Barrande, in Barrois' Faune du Calcaire d'Erbray, 1889, p. 233, pl. 17, fig. 2.) The anterior portion of the annulations is covered with granules varying considerably in size, becoming quite conspicuous tubercles on the median and two adjacent ribs.

This specimen was collected by Mr. D. D. Luther, of Naples, from the lower beds of the Chemung group, in a gully opening into Italy Hollow, Yates county, and extending southward within the northern boundary of the town of Prattsburgh, Steuben county. Attached to the specimen is the impression of a dorsal valve of *Productella speciosa* or *lachrymosa*, and a number of fragments of *Fenestella*. The horizon at which it occurs can not be far above or below that of the peculiar *High Point fauna* occurring in the adjoining township of Naples, Ontario county, and discussed by the writer in Bulletin No. 16, U. S. Geological Survey (pp. 72–76, 1885). It was shown in this paper that the first appearance of a characteristic Chemung fauna in this section,

is in the "Portage sandstone" at a distance of about 600 feet below the limit currently assigned to the upward extension of these sandstones, or 600 feet below the first *Spirifer Verneuili* fauna; that, further, this first Chemung fauna was underlaid, at a distance of a few feet, by the last remnants of the Naples or Cashaqua fauna (*op. cit.*, pp. 67, 68). We may, then, regard the horizon of *Bronteus senescens* as being pretty well up in the lower portion of the Chemung, and its appearance nearly contemporaneous with that of *Spirifer Verneuili*. For our American faunas this indicates a considerable progress into the upper Devonian, succeeding the *Cuboides fauna* (Tully limestone) and the *Intumescens fauna* (Naples beds) which are distinctly separated in New York, but usually commingled in England and on the Continent, and constitute the primary stage of the upper Devonian. This is probably the latest appearance recorded of the genus *Bronteus*.

[The original specimen of this species has been presented to the New York State Museum.]

A List of the Species Constituting the Known Fauna and Flora of the Marcellus Epoch in the State of New York.

Communicated to JAMES HALL, State Geologist, by J. M. CLARKE.

‡ Bituminous shales.

† Goniatite limestone.

* Limestone layer, ten feet from the base of the formation. This single layer of limestone extends from Ontario county, on the east, probably to Lake Erie. Its easternmost outcrop is on the banks of Flint creek, near the village of Orleans, and its best development near the village of Stafford, Genesee county, where it attains a thickness of from eighteen inches to two feet, has been quarried and has proven of considerable value for undressed work. Its extent and position in the shales was pointed out by Professor James Hall, in his report on the Fourth District of N. Y., 1843.

Species continuing their existence into the later faunas of the Hamilton group are in italics.

PISCES.

‡* Undetermined plates and scales.
‡ Coccosteus sp. ?

ANNELIDA.

* Spirorbis sp. n.
‡ Arabellites sp.

ARTHROPODA.

‡* *Homalonotus DeKayi*, Green.
‡* *Phacops rana*, Green.
* *Dalmanites (Cryphœus) Boothi.* var. *Calliteles*, Green.
† *Proëtus Haldemani*, Hall.
* *P. macrocephalus*, Hall.
* *Cyphaspis craspedota*, Hall.
‡ Mesothyra (Dithyrocaris ?) Veneris, Hall.
‡ Protobalanus Hamiltonensis, Whitfield.
* Leperditia, sp.

CEPHALOPODA.

‡†* *Nautilus liratus*, Hall.
† *N. bucinum*, Hall.
‡ *N. oriens*, Hall.
* *N.* cf. *magister*, Hall.
† N. (Discites) Marcellensis.
‡† *Goniatites discoideus*, Hall.
‡ G. plebeiformis, Hall.
† G. Vanuxemi, Hall.
† Gyroceras transversum, Hall.
‡ G. sp.
† Cyrtoceras liratum, Hall.
† C. alternatum, Hall.
† Gomphoceras Fischeri, Hall.
‡ G. cf. Fischeri, Hall.
† G. solidum, Hall.
† G. oviforme, Hall.
† G. Conradi, Hall.
‡ G. sp.
‡* *Orthoceras subulatum*, Hall.
‡† O. Marcellense, Vanuxem.
† O. fustis, Hall.
† O. aptum, Hall.
‡ O. Sicinus, Hall.
‡ O. Thestor, Hall.
* *O. Aegea*, Hall.
‡* *O. nuntium*, Hall.
* *O. crotalum*, Hall.
* O. n. sp., cf. Œdipus, Hall.
* *O.* cf. *cœlamen*, Hall.
‡ Bactrites clavus, Hall.
‡ B. sp. n.

PTEROPODA.

‡ *Conularia continens*, Hall.
‡ *Pharetrella tenebrosa*, Hall.
† Coleolus (Dentalium) aciculatum, Hall.
*‡ *Styliolina fissurella*, Hall.
† " " var. strigata, Hall.
‡ *Tentaculites gracilistriatus*, Hall.

Gastropoda.

* *Platyceras attenuatum*, Hall.
* *P. bucculentum*, Hall.
* *Cyrtolites mitella*, Hall.
* *Bellerophon lyra*, Hall.
‡ *B. Leda*, Hall.
* *Platyostoma lineatum*, Conrad.
* *Pleurotomaria Lucina*, Hall.
‡†* *P. rugulata*, Hall.
* *P. Itys*, Hall.
* *P. capillaria*, Conrad.
* *P. sulcomarginata*, Conrad.
* *Loxonema Hamiltoniæ*, Hall.
* Scævogyra? sp. n. (A sinistral shell without peripheral seam.)

Lamellibranchiata.

‡ Aviculopecten invalidus, Hall.
* Pterinopecten exfoliatus, Hall.
‡ P. dignatus, Hall.
‡ P. lætus, Hall.
‡ *P. intermedius*, Hall.
‡ Actinopteria muricata, Hall.
‡ A. Doris, Hall.
*‡ *Leiopteria lævis*, Hall.
‡ Leptodesma Marcellense, Hall.
‡ *Modiomorpha alta*, Conrad.
‡ *Goniophora acuta*, Hall.
* Goniophora sp.
‡ *Nuculites triqueter*, Conrad.
‡ *N. Nyssa*, Hall.
† Panenka ventricosa, Hall.
‡ P. Hero, Hall.
‡ *P. æquilatera*, Hall.
*‡ P. costata, Hall.
‡ P. Lincklæni, Hall.
‡ P. mollis, Hall.
* *P. radians*, Conrad.
‡ Panenka sp. n.
‡ Cardiopsis, sp.
*‡ *Lunulicardium fragile*, Hall.
‡ L. Marcellense, Vanuxem.
† L. rude, Hall.
‡ L. orbiculare, Hall.
‡ *L. curtum*, Hall.
‡ *Cardiola retrostriata*, von Buch.
‡ *Phthonia nodocostata*, Hall.

Brachiopoda.

* *Terebratula Lincklæni*, Hall.
* *Cryptonella planirostra*, Hall.
* *Rhynchonella Sappho*, Hall.
* *R. Horsfordi*, Hall.
* *Rhynchonella Dotis*, Hall.
* *R. prolifica*. Hall.
* R. sp ?
‡ Leiorhynchus limitaris Vanuxem
‡ *L. quadricostata*, Hall.
‡ *L. multicosta*, Hall.
† *Spirifer mucronatus*, Conrad.
* *S. medialis*, Hall. (*S. audaculus*, Conrad.)
‡ *S. fimbriatus*, Conrad. (*S. Conradanus*, Miller.)
* *S. subumbona*, Hall.
‡ *Ambocœlia umbonata*, Conrad.
* *Meristella Barrisi*. Hall.
*‡ *Strophalosia truncata*, Hall.
* *Productella spinulicosta*, Hall.
* *P. Shumardiana*, Hall.
*‡ *Chonetes mucronata*, Hall.
*‡ *C. scitula*, Hall.
*‡ *C. lepida*, Hall.
‡ *C. setigera*, Hall.
‡* *Tropidoleptus carinatus*, Conrad.
* *Strophodonta inæquistriata*, Conrad.
* *Streptorhynchus Chemungense*, Conrad.
* *Orthis Vanuxemi*, Hall.
* *O. cyclas*, Hall.
*‡ *Crania Hamiltoniæ*, Hall.
‡ Orbiculoidea minuta, Hall.
‡ *O. media*, Hall.
‡ *O. humilis*, Hall.
‡ Lingula exilis, Hall.

Bryozoa.

‡ Polypora, sp.
‡ Paleschara sp.
* *Hederella Canadensis*, Nicholson.
* Stictopora sp.
* Lichenalia sp.
‡ *Reptaria stolonifera*, Rolle.

Echinodermata.

† Haplocrinus Clio, Hall.
* *Nucleocrinus Lucina*, Hall.

Polypi.

‡ Microcyclus, sp.
* Romingeria, sp.
* *Striatopora limbata*, Eaton.

Plantæ.

‡ Rachiopteria pinnata, Dawson.
‡ Protosalvinia Clarkei, Dawson.
‡ *P. Huronensis*, Dawson.

THE HERCYNIAN QUESTION.

A Brief Review of its Development and Present Status, with a few Remarks upon its Relation to the Current Classification of American Palæozoic Faunas.

Communicated to the Report of the State Geologist for 1888, by J. M. Clarke.

At a meeting of the German Geological Society, held at Berlin, March 6, 1867,* Prof. E. Beyrich directed attention to the character of the fossil faunas contained in the lenticular limestones, intercalated in the greywackes and slates of the Northern Hartz, in the vicinity of Zorge and Wieda. Meager representations of these faunas had been studied by Friedrich Adolph Rœmer in 1844,† and were regarded by him as indicating an Upper-Silurian age; but in the fifth of his subsequent contributions‡ to the palæontology of this region, he expresses the view that these were to be regarded as of Devonian age, and termed the beds *Wissenbach limestones,* of equivalent horizon to his *Wissenbach shales,* which he regarded as the parallel of the Rhenish *Wissenbach shales.* These limestones he separated faunally from those of the Eastern Hartz near Mägdesprung and Harzgerode, and of the Northern Hartz near Ilsenburg, which he still regarded as of Upper-Silurian age. This separation was based essentially on the occurrence of Goniatites in the limestones of Zorge and Wieda, while they were unknown in the limestones of the Eastern Hartz. Beyrich, with new data at his disposal, took exception to this view, finding in the molluscan (especially Brachiopod and Capulid) characters of the various exposures of the fauna, essential unity and Lower-Devonian import; he furthermore suggested the direct parallelism of the fauna with that of the upper *étages* of the Bohemian basin (F, G, H). Barrande had regarded the fauna of his *étage* E as typical Silurian (=Wenlock-Niagara), and those of his subsequent *étages* as a post-, or supra-typical–Upper-Silurian, without an exact equivalent in the European palæozoic. Certain specific identities and affinities in the Hartz and Bohemian faunas had already been established, and therefrom Beyrich suggested that the *étages* F, G, H, might properly be

* Zeitschr. der deutsch. geolog. Gesellsch, Vol. XIX, p. 247, 1867.
† Versteinerungen des Harzgebirges, 1844.
‡ Beiträge zur geolog. Kenntn. d. nordw. Harzgeb. V, 1866.

regarded as a richly fossiliferous *Lower-Devonian limestone* formation, which was related to sparsely fossiliferous Lower-Devonian shales and greywackes, just as is the richly fossiliferous Carboniforous limestone to the sparsely fossiliferous Culm.

The propositions of Beyrich, though made informally and left to await elaboration for a period of eleven years, embody the germ of the whole discussion of the "Hercynian question," which, for eleven years past, has been the chief concern of palæozoic geology upon the continent of Europe.

In 1878 appeared Prof. Emanuel Kayser's now justly famous work on the "Fauna of the oldest Devonian Formations of the Hartz Mountains." *

This was a most detailed and incisive presentation of Beyrich's proposition, embodying the description of a very considerable fauna from the lenticular limestones of Zorge, Wieda, Mägdesprung, Hasselfelde, etc., and affording comparisons with all known faunas presenting features indicative of equivalence.

In the region under consideration the nomenclature applied to the formations by A. Roemer, was as follows, beginning with the oldest: *Tanner Grauwacke* —— *Untere Wieder Schiefer* —— *Hauptquarzit* —— *Obere Wieder Schiefer*. The *Tanner Grauwacke* bearing only (with a possible exception) plant remains, Knorrias, *Sagenaria*, *Lepidodendron*, etc., had been referred by Roemer, at certain of its outcrops, to the Culm, and though previously to 1878, it was recognized in Lossen's geological map of the Hartz, as at the base of the palæozoic formations of this region, its characters did not come up for extended consideration. The *Hauptquarzit* was subsequently shown to contain a fauna essentially equivalent to that of the *Spiriferensandstein* of the Kahleberg and Schalke in the lower Hartz. The *Untere Wieder Schiefer* constitute the beds bearing the oldest fauna of the Hartz. In their outcrops neither continuity nor consecuity can often be traced, but they were divided by Kayser into: "Shales of the lower zone with the *limestone* fauna of Mägdesprung, Hasselfelde, Zorge, Ilsenburg, etc., and with the plant-bearing greywackes of Strassberg, Stolberg, etc.—— "Shales of the upper zone"—— "Graptolite horizon." This series (*Untere Wieder Schiefer*) was designated "Hercynian shales" and its fauna as a whole, the "Hercynian fauna."

The characteristic elements of this Hercynian fauna (in which the number of species rose to 200) were as follows:

Devonian. Brachiopods: Abundant Spirifers (17 species), among

*Die Fauna der ältesten Devon-Ablagerungen des Harzes: Abhandl. zur geolog. Special Karte Preuss. u. den Thür. Staat., Bnd II, Heft 4, 1878.

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which are the *long-winged* forms, and those with *few* and *coarse* plications, "which for formations of Devonian and later" (palæozoic) "age are as characteristic as they are infrequent in those of præ-Devonian age." *Cyrtina* of very large size, and a septate, high-areaëd *Spirifer;* a large *Megalanteris;* Orthids of the type of *O. striatula; Chonetes* of large size; Rhynchonellas with few and coarse plications.

Trilobites: The occurrence (sparse) of *Cryphœus; Dalmanites* of the type of *D. Hausmanni*, (*Hausmannia*);* *Phacopes* with obsolescent but apparent glabellar furrows, and compound pygidial pleuræ (*P. fecundus*, etc.), and the absence of all characteristic Silurian genera, e. g., *Ampyx, Sphærexochus, Staurocephalus, Asaphus.*

Cephalopods: *Orthoceras* of the type of *O. triangulare, O. Jovellani* (*Jovellania,* with subtriangular septal section and marginal sipho); *Hercoceras; Gyroceras* of the type of *G. tetragonum;* Nautiline Goniatites (*G. subnautilinus, G. latiseptatus, G. neglectus, G. evexus,* etc.) a type extending in rare instances, in the Devonian of Europe and America, above the limit of the Middle-Devonian.

Gastropods: A remarkable development of the Platyceratidæ (*Capulus, Orthonychia, Hercynella*).

Lamellibranchiata: Pterineas (*Actinopteria, partim*) *Allorisma, Pleurophorus,* identical in species with those in the Rhenish Devonian; large, many-ribbed Cardiolas (*Panenka*).

Corals: *Pleurodictyum, Amplexus, Beaumontia* and *Chœtetes,* the latter similar to, perhaps identical with French and American Lower-Devonian species.

Though these Devonian elements prevail, there are, on the other hand some important *Silurian* features. Among the brachiopods, Spirifers with low, indistinct plications and finely, radiately-striated shell (type of *S. plicatella, S. radiata*†); *Pentamerus** of the type of *P. Knighti.*

Rhynchonellas with numerous fine plications. Among the trilobites, *Bronteus* with smooth aspinous margin. The cephalopods have two species identical with the Bohemian typical Silurian, E. Of the lamellibranchs, *Cardiola interrupta,* so widely diffused in the Upper-Silurian. The surprising Graptolite fauna is confined to the upper horizon of the Hercynian beds. Eight species are identified, all with a single row of cells (*Monograptus*). This element is regarded not as nullifying the positive Devonian expression of the underlying fauna, but as serving to emphasize its great age.

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*More properly this character may be regarded, not as diagnostic of the Silurian or Devonian in their typical development, but as one of the most important peculiarities of the Hercynian constitution.

†*Spirifer Davousti* and *Pentamerus rhenanus*, species following these types respectively are from the Lower-Devonian.

The Devonian characters of this Hercynian fauna are predominant, and are regarded as indicating not only a Lower-Devonian, but an earliest Devonian age or equivalence.

In comparing this fauna with that of the upper étages of the Bohemian basin, KAYSER found over fifty species, or rather more than twenty-five per-cent of the former, represented in the latter by forms, either identical or closely allied.*

BARROIS † subsequently turned this statement in a somewhat different light, by adding that the per-centage would be materially lessened by comparison of the concurrent species with the 2,000 species described by BARRANDE from the Bohemian; in other words, that the proportion was not reduced to a common denominator. Nevertheless, KAYSER'S deduction of the equivalence of the F, G, H fauna with the Hercynian, is not affected by the reversal of this proposition, as by far the greater number of the Bohemian species, are, as far as yet known, indigenous and not diagnostic. The summary statement of the characters of the Bohemian fauna in question is given substantially as follows: ‡ In spite of many Silurian characters, it bears a pronounced Devonian expression, especially shown in its Goniatites, numerous Devonian brachiopod types, the absence of all excluively Silurian cephalopod and trilobite genera. The Silurian affinities are indicated primarily by a few Upper-Silurian brachiopods, by *Calymene* and the Graptolites, and secondarily, by numerous Dalmanites§ and Trochocerata. Compared with the Hartz fauna, with numerous and fine Devonian brachiopods and corals (?) the Bohemian fauna possesses more features suggestive of the Silurian. In the extraordinary agreement of both faunas, the decisive Devonian character of the Hartz Hercynian exerts its influence on the Bohemian fauna, while the latter, as it affords some doubt of its age when considered by itself, by comparison shows its relation to the Devonian.

Besides these comparisons with the Bohemian upper faunas, the author elicited points of equivalence with faunas in other regions; those of Thuringia, Franconia and the Fichtel Mts., of the Rhenish provinces, western and southern France, and of North America.

The propositions enunciated by KAYSER in regard to the age and equivalence of his Hercynian fauna, though warmly espoused by the German geologists generally, met with strong opposition on certain issues.

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* Op. cit., p. 254.

† Faune du Calcaire d'Erbray, p. 299, 1889.

‡ Kayser, p. 262.

§ We have elsewhere referred to the fact, now well established, that the predominance of typical *Dalmanites* (*Hausmannia*) is a most important character of early Devonian faunas.

Emil Tietze* urged that the normal or classical Devonian, as defined by Murchison and Sedgwick, had for its base the *Linton beds*, with a fauna equivalent to that of the Spiriferensandstein or Coblenzian, and that a supposably older fauna could not properly be admitted within the original limits of the Devonian division. Kayser† replied that the same line of argument would exclude from the typical Silurian all the Bohemian étages above E, and thus leave the F, G and H étages and their equivalents in a position between Silurian and Devonian, but belonging to neither; a conception indeed not widely remote from that entertained by Barrande in regard to his upper étages. Barrois ‡ subsequently refers to the fact that the *Looe greywackes* of Cornwall, which are older than the Linton beds, contain a fauna § probably older than the Coblenzian and, inferentially, equivalent to the Taunusian if not to the Gedinnian.

Tietze further makes the important point, that, as the determination of the faunal quantivalences may be to a large degree a matter of personal opinion, there is no reason why the Graptolite element of the Hercynian is not as conclusive of Silurian age as the Goniatites are of Devonian. Kayser in reply showed that aside from either of these elements the import of the fauna was preëminently Devonian.

Prof. Clemens Schlüter ‖ demurred to Kayser's position that the Hercynian was a parallel formation of the Spiriferensandstein (Coblenzian) or a calcareous facies of its normal arenaceous fauna.

Barrande¶ protested that Kayser's identifications of Bohemian species in the Hercynian were of questionable value, and entered into a protracted analysis of the twenty-two brachiopod species, held by Kayser to be identical or analogous in the Hartz and Bohemia, and came to the surprising conclusion that of all these, but *one* species was correctly identified and that but few of the suggested analogies were admissible. These views have not, however, received general acceptance with the discutants upon this subject.

In 1881, Kayser** essentially modified his conception of the age of the Hercynian fauna. The *Hauptquarzit* overlying the *Untere Wieder Schiefer* or Hercynian had proved itself a representative in part of the Coblenzian, *i. e.*, later Lower-Devonian, and so intimately united petrographically and faunally with the beds immediately beneath,

*Jahrbuch d. K. K. geolog. Reichsanst. zu Wien, p. 743, 1878.

†Zeitschr. d. deutsch. geolog. Gesellsch. Vol. xxxi, p. 54, 1879.

‡Faune du Calcaire d'Erbray, p. 284, 1889.

§The species of this fauna are given by Davidson, Brit. Devon. Brachiopoda, vol. 3, pp. 106, 126, 1865.

‖Verhandlung des naturhist. Vereins für Rheinl. u. Westfalen, p. 330, 1879.

¶Système Silurien du Centre de la Bohême, Vol. V, p. 167 *et seq.*

**Zeitschrift d. deutsch. geolog. Gesellsch. Vol. XXXI, p. 624.

that the author was disposed to regard the latter no longer as of very early Lower-Devonian age, but possibly equivalent to one of the lower members of the Rhenish Coblenzian, but not so old as the Taunusian or Gedinnian.

In 1884,* however, in discussing the question of the limit between Silurian and Devonian in Bohemia, Thuringia and elsewhere, without referring directly to the quantivalence of the Hartz Hercynian, he uses the term Hercynian throughout as equivalent to *basal Devonian*, and we are left to infer that he quietly abandons his view of 1880, returning to his original conception of the age of this fauna. In this place, also, reasons are adduced for drawing the dividing line between Silurian and Devonian in Bohemia, not between E and F, but through the étage F between the zones F_1 and F_2. This is proposed on the ground of the absence of Devonian piscine types in beds older than F_2; the first appearance of *Dalmanites* (*Hausmannia*) and *Bronteus* (*Thysanopeltis*), of Goniatites, *Gyroceras*, *Stringocephalus*, etc., in this zone.

This subdivision of F was opposed by Dr. Ottomar Novak, Curator of the Barrande Collection in Prague, in 1886,† who demonstrated that the two zones were not consecutive, but most probably continuous and different facies of the same fauna. Novak followed Kayser's original conception of the equivalence of the F, G, H fauna with the Hercynian, and adopted this term for this Bohemian fauna in its entirety.‡

While Kayser, Novak and others still remained disposed to regard the Hercynian of the Hartz as a strictly lower (*lowest?*) Devonian deep sea fauna, parallel to the arenaceous fauna in the normal Rhenish Lower-Devonian (Coblenzian) and equivalent to the Bohemian faunas from F (F_2?) to H, taken in their entirety, the study of the Bohemian faunas with special relations to their equivalence with those of the Rhenish and Westphalian Devonian, educed essential modifications of this view.

The matter was presented in a new light by Dr. Fritz Frech, at a meeting of the German Geological Society, December, 1886.§

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* Kayser: Ueber die Grenze zwischen Silur and Devon (Hercyn) in Böhmen, Thüringen und einigen anderen gegenden; Neues Jahrb. für Mineral. etc., 1884, Vol. II, p. 81.

† Zur Kenntniss d. Fauna d. Étage F—f_1 etc.; Sitzungsber. d. k. böhm. Gesellsch. d. Wissensch. 1886.

‡ We have purposely avoided reference to the phase of the Hercynian discussion, involving the faunas at Bicken, the Greifenstein, Bieber and elsewhere in Westphalia. The encounters between Kayser and Maurer in this direction have been vigorous, but the main issues of the question appear to be less involved here than in the other fields indicated. See, for example, Maurer; Die Fauna der Kalke von Waldgirmes; Abhandl d. Grossherzog. Hess. geolog. Landesanst zu Darmstadt, Vol. I, Heft 2, 1885, p. 309, and Kayser's review of the same in the Neues Jahrbuch für Mineral. 1886, Vol. 2, p. 109.

§ Zeitschr. d. deutsch. geolog. Gesellsch, Vol. 38, p. 917, 1886,

Kayser's reason (invalidated by Novak) for drawing the line between Silurian and Devonian in Bohemia through the étage F, lay principally in the absence of Goniatites in F_1. Frech would regard this as indicating a divergence in facies and compared it to the state of affairs frequently apparent in the Eifel; for example, the essential absence of Goniatites in the *Calceola beds,* and their great abundance in the *Wissenbach slates,* formations and faunas substantially equivalent. Upon other faunal grounds, the speaker found in F_1 a conspicuous divergence from the normal Upper-Silurian in the absence of the trilobite genera *Ampyx, Cromus, Deiphon, Staurocephalus, Sphærexochus* and in the extremely meager representation of *Calymene;* furthermore a relatively very small per-centage of species are common to E and F, while a greater number pass through from F to G. The base of the Devonian is, therefore, placed at F, in accordance with the original conception of Beyrich and Kayser. Dr. Frech then called attention to the *Tentaculite* layers of the zone G_2, and compares them with the *Tentaculiten Schiefer* of Thuringia and Nassau, considering the latter as lowest Middle-Devonian (in accordance with Kayser's determination) and supporting the comparison and equivalence by the identification of *Strophomena comitans,* Barrande (G_2) with *S. subtransversa* Schnur, of the Eifel Middle-Devonian. Evidence of more decisive import in regard to the equivalence of G_3 is adduced from the character of the *Goniatite* facies. Of these fossils, four species are common to G_3 and the *Orthoceras Schiefer* of the Rhine (lowest Middle-Devonian, according to Kayser; uppermost Lower-Devonian according to Koch and Maurer). Frech also regarded the species described by Barrande as a lamellibranch under the name *Zdimir solus* as hardly to be distinguished from *Uncites gryphus.* The value of this comparison, however, falls to the ground from the subsequent determination by Novak* that this fossil is a *Pentamerus,* and it appears to be of the peculiar, elongate, strongly-ribbed type characterizing the Niagara species, *P. laqueatus,* Conrad.

Frech's subdivision of the Upper Bohemian then took this expression:

$$\left.\begin{array}{l}H\\G_3\end{array}\right\}=\text{Middle-Devonian.}$$

$$G_2=\text{? Middle-Devonian.}$$

$$\left.\begin{array}{l}G_1\\F_2\\F_1\end{array}\right\}=\text{Lower-Devonian.}$$

$$E_2=\text{Upper-Silurian.}$$

* Zeitschr. d. deutsch. geolog. Gesellsch. Vol. XL. Heft, 3, p. 588, 1888.

Thus F, G, and H, in Kayser's conception the equivalent of the Hartz Hercynian, were regarded as possessing a far more extensive and general Devonian character, capable of subdivision; and in a *secondary* sense the value of the term *Hercynian* was broadened, until from having a local value in the expression of an earliest Devonian fauna, it had come to be an equivalent (as far as concerned Bohemia) for nearly the entire Devonian system. Still the suggestion could not affect the proper conception of the Hercynian as a lowest Devonian fauna, but was of much importance as an effort to ascertain the exact equivalences in the great succession of calcareous faunas in Bohemia.

In 1887, Frech published a memoir of great interest on the Palæozoic formations of Cabrières in Languedoc,* a palæozoic "oasis" which had previously received cursory attention from Fournet, Graff, De Rouville, Tromelin and Grasset, Barrois and von Kœnen. The series of deposits represented by the various profiles given extends from the *Amorican grits* (considered the limital formation between Primordial and Silurian) to the *Carboniferous limestone.* The uppermost faunas of the Lower-Silurian and the oldest of the Upper-Silurian appear to be wanting. The later Upper-Silurian is paralleled with the étage E_2 on the basis of the identification of a number of Bohemian species. The Lower-Devonian lacks the earliest fauna (regarded as the equivalent of F_1); that of the white limestone of the Pic de Cabrières is considered as essentially the equivalent of F_2 (Konieprusian), while the silicious limestone of Bissounel with interlaminated coral banks, is the parallel of G_1. The Middle-Devonian faunas in the Val d'Isarne, the shales of Ballerades and Bataille, are regarded as homologues of the zones G_2, G_3, and H respectively, while H is considered as possibly represented in the lower and middle elements of the Upper-Devonian.

Again, the same author, in 1888, in a remarkable series of investigations on the palæozoic of the eastern Alps in Styria and Carinthia,† which had previously been studied by Stur, Clar, Stache and Hœrnes, reiterated with amplification, his proposed subdivision of the Bohemian upper *étages.*

In the Carinthian Alps, the succession presented in the western section in the Wolayer Thörl and the Plöcken, and in the eastern section at Osternigg, the representative of E_2 (Upper-Silurian) divides itself into three zones: (1) that of *Orthoceras potens* and other species, *Encri-*

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*Zeitschr. d. deutsch. geolog. Gesellsch. Vol. xxxix, Heft 2, pp. 360-488. Die palæozoischen Bildungen von Cabrières (Languedoc).

† Ueber das Devon der Ostapen: Zeitschr. d. deutsch. geolog. Gesellsch. Vol. xxxix. Heft 4. pp. 659-739. 1888.

nurus Novaki, Arethusina, Ampyx, Cardiola interrupta, etc.; (2) that of *Orthoceras alticola* and other species, *Antipleura Bohemica, Phacops* with elongate Dalmanitiform glabella and distinct glabellar furrows; (3) that of *Spirifer secans, S. viator, Cheirurus, Cyphaspis, Rhynchonella cuneata.* To the lowest Devonian (Hercynian) was referred the upper part of E_2 represented by the zone of *Goniatites* (*Tornoceras*), *G.* (*Anarcestes*) and *Cyrtoceras Miles*, and the zone of *Rhynchonella Megœra, Athyris obolina, Atrypa marginalis, Rhynchonella Sappho* (Barr., not Hall). To the younger Lower-Devonian (paralleled with F) is referred a coral limestone with *Rhynchonella princeps, R. amalthea Pentamerus procerulus, Spirifer superstes* and others, *Orthis palliata*, etc. (Bohemian species.) $G_1 - G_2$ are regarded as intermediary between the Lower and Middle-Devonian, G_3 as upper Middle-Devonian, with *Stringocephalus Burtini, Macrocheilus arculatum, Alveolites suborbicularis;* while H, as a remnant, is considered as a possible equivalent of the lower and upper Upper-Devonian zones, the former with *Rhynchonella pugnus, Productus subaculeatus,* the latter with Clymenias, *Goniatites delphinulus* and *Phacops cryptophthalmus.*

We may well leave to Dr. FRECH the onerous task of verifying these extreme views in regard to the subdivision and equivalence of the Bohemian upper *étages*, and turn to a brief notice of more recent views in regard to the Hercynian, evincing far greater conservatism, expressed by Prof. CHARLES BARROIS in a work entitled "Faune du Calcaire d'Erbray; Contribution a l'etude du Terrain dévonien," 1889.*

In this elaborate volume is given a thorough presentation of the status of Hercynian discussion and a searching analysis of its merits.

The hamlet of Erbray, in the commune of the lower Loire, had been made known to geological science, through the announcement by CAILLAUD, in 1861, that the limestones of this district contained a fauna comparable to that of the third Silurian fauna of Bohemia; the same year BUREAU had expressed the opinion that the fauna contained a commingling of Upper-Silurian and Lower-Devonian fossils. BARROIS has divided these limestones into (1) the white limestone with *Capulus*, (2) blue limestone with *Spirifer Davousti.* It is with the fauna of these beds that the body of the work is mainly concerned, and its expression, embodied in about 200 species, leaves little to be expected for future workers.

The salient diagnostic features of this fauna, both positive and negative, are: 1. TRILOBITES: *Phacops* (*P. fecundus* with duplicate pygidial pleuræ); *Cryphæus; Proëtus* (six species, two of which occur in F, one in G); *Bronteus Gervillei*, with the median pygidial rib faintly, if

* Mémoires de la Société géol. du Nord. Tome III. April, 1889.

at all, bifurcate, representing a group reaching its maximum in the Lower-Devonian; no representative of *Thysanopeltis* or the group of *Bronteus* with spinous pygidial margin, a division of later Devonian culmination; *Harpes* (E and F species); *Cheirurus* (F and G species); no representative of *Dalmanites* (*Hausmannia*) so abundant in the Hercynian and F, G étages. Cephalopods: Species in part identical with those of the Coblenzian and E, F and G. *Jovellania* (group of *Orthoceras triangulare*), which predominates in the Hercynian. Gastropods: *Platyceras* in great numbers * (eighteen species), as in the Hercynian; *Hercynella* (?), a Hercynian genus; *Strophostylus* (F, Hercynian); *Bellerophon Pelops* (F, Upper Helderberg); *Horiostoma*, species allied to those of the Coblenzian limestone and differing from those of the Gotländerkalk. Lamellibranchs: *Limoptera; Paracyclas; Conocardium* (abundant); *Cardiola; Panenka* is absent. Brachiopods: Rhynchonellas related to those of the Lower Helderberg and F; *Athyris* (11 species) represented by Coblenzian forms (a genus rare in the Bohemian, Hercynian and Lower Helderberg); *Atrypa reticularis* and its varieties (six); *Ambocoelia umbonata* agreeing with Oehlert's identification; *Orthis* of the type of *O. striatula; Pentamerus* of large size and coarse ribs, characterizing the Lower-Devonian limestone faunas (in Europe; Barrois, p. 302); *Megalanteris; Spirifer* with great median septum (*S. robustus*); long-winged forms (*S. paradoxus* var. *Hercyniæ*); forms with costate fold and sinus (*S. Trigeri, Jouberti*); in general, species identical or closely related to forms of the Hercynian, and belonging to groups expressive of Devonian age. Corals: *Cyathophyllum; Zaphrentis; Amplexus; Heliolites; Favosites; Chætetes; Alveolites; Striatopora; Pleurodictyum* and *Petraia* are absent.

The general harmony of this fauna with the typical Hercynian is apparent even from this brief summary; furthermore, it is evident from the foregoing, and is shown more emphatically in the detailed tabulation of species and their equivalences given by Barrois, that there are many points of alliance with the Bohemian F and G and the Coblenzian.

At the base of the Devonian system in western Europe is the Gedinnian (according to Hébert, Murchison, Dumont and Gosselet). "This étage presents a certain number of arenaceous and calcareous equivalents. The principal arenaceous facies here cited, are the beds of Mondrepuits, Looe, Cathervieille, Oriskany; the principal calcareous facies,

* Les *Capulus*, Montf., donnent à la faune d'Erbray, un cachet essentiel, par leur abondance et la variété de leurs formes; et si l'usage, préconisé par quelques auteurs, de désigner les étages par leurs fossiles, tels que *l'Astartien*, le *Virgulien*, avait prévalu, c'est certes, au nom de Capulien, que l'on devrait donner la préférence pour désigner cette phase de la période paléozoique." (Op. cit., p. 186.)

interesting because they show the insensible passage from Devonian to Silurian, are the limestones of Erbray, the Hercynian limestones of the Hartz, the étage G of Bohemia, the Upper Helderberg, the limestone of the Carinthian Alps, of the Urals, etc." (p. 325). "The Coblenzian does not form the base of the Devonian, as frequently asserted by too many authors accustomed to consider the Rhine as the classical region. This Coblenzian étage, like that directly below" (Gedinnian) "also presents two distinct facies in the west of Europe; one arenaceous-schistose (greywackes of the Meuse and Rhine), the other calcareous (the beds of Néhou in Brittany, in the Pyrenees and the Asturias). These Coblenzian limestones, like the Eifelian limestones overlying, (Greifenstein, Porsguen) have a *faune propre*, which in France we know well, from the labors of M. Oehlert. These species characterizing the calcareous Coblenzian, are associated with others occurring in the greywacke of the Meuse and of the Rhine, as well as some Bohemian Silurian forms" (p. 325). From an analysis of the calcareous Coblenzian fauna, Professor Barrois arrives at the conclusion that it is distinct both from the Hercynian and the Eifelian, younger than the former, older than the latter, and that therefore the fauna of the Erbray limestones, equivalent to the Hercynian and the étage G, the Oriskany and Upper Helderberg (in part), represents the calcareous facies of the Gedinnian, or an earliest Devonian pelagic fauna.

It will be observed that while this expression in regard to the age of the Hercynian is in harmony with Kayser's first conception, it does not agree with his original suggestions of equivalence with the Coblenzian, nor with his later views in regard to its age.

The oscillations of the Hercynian ideas, have, in fine, been essentially these: A. Rœmer (1843) regarded the fauna in its typical (Hartz) development, as Upper-Silurian; subsequently the Cephalopod facies and Brachipod facies thereof as representing distinct faunas, the former Devonian, the latter Silurian; Beyrich (1867) believed the two faunas of Rœmer, one, and suggested their equivalence to the Bohemian F, G, H, and their relation to the Devonian; Kayser (1878) demonstrated their unity and Devonian character and regarded them as the lowest beds of the Devonian, representing a calcareous facies of the Coblenzian fauna of the Rhine, and paralleled with them the Bohemian F, G, H fauna taken in its entirety; in 1880 he regarded them as a lower (not lowest) Devonian fauna, but still a calcareous facies of the Coblenzian; in 1884 he appears to have resumed his original position in regard to the age of the Hercynian, modifying his conception of the parallelism in the Bohemian fauna by removing from his equivalent the lower portion of F. Novak (1886) showed

that the fauna of the étage F was not divisible except into different facies. FRECH (1886) made the Bohemian a representative of the Devonian series to the top of the middle division, and F the equivalent of the Hercynian as lowest Devonian; in 1887 he placed the base of the Bohemian Devonian at E_2 (Hercynian); BARROIS (1889) made the Hercynian, with BEYRICH and KAYSER (1878, not 1880) a lowest Devonian fauna, but differed from KAYSER (1878, 1880) in regarding it, not as a calcareous facies of the Spiriferensandstein or Coblenzian, but as such a facies of the older Gedinnian, considering the Bohemian G as its equivalent.

In our own country the succession of Silurian and Devonian faunas is so unbroken that it would be difficult to conceive of a controversy of this nature taking origin on American soil. The real source of the discussion may be found in the conception held by BARRANDE in regard to the faunal equivalence expressed in the Bohemian "Silurian" basin. While admitting the homotaxy with the Silurian of Murchison, up as far as the top of the étage E (which was to be regarded as the representative of the Wenlock and Ludlow), he looked upon the extensive faunas of F, and G as Silurian, and records of Silurian life and time not preserved within the upper limits of the Silurian as originally consituted. Were the demands of priority to be insisted upon here, as some writers require, these would necessitate drawing the dividing line between Silurian and Devonian at the top of E (assuming that to be the proper equivalent of the English highest Silurian); but with these considerations aside (and it is very dubitable if historical precedence in defining the secular limitations of faunas can be enforced with any logical exactitude), there can be no question that the F, G, and H faunas were correctly referred to time later than that represented in the classical sections of the Silurian, if these faunas do contain a predominance of Silurian types. Although, in determining such a question, there must always be generous allowance for the personal equation in apprehending the diagnostic values of types, we may accept the now essentially united opinions of the European investigators, that these Bohemian faunas do contain a preponderance of Devonian over Silurian types, and probably, also, that the successive culmination of different Devonian types in successive étages, furnishes evidence of equivalence, not merely to one Devonian fauna, but to successive Devonian faunas.

Though not finding in Europe an equivalent of his F, G, H, BARRANDE believed one to exist in the distant Upper Helderberg faunas of New York, which he ever regarded as of Upper-Silurian age, and evidence of this correspondence in faunas has been amplified by the studies of

Kayser, Novak, and Barrois; so that the essential difference in the views of Barrande and his critics lies, not so much in the determination of the faunistic equivalents of F, G, H, as in the secular value of their faunal characters; a case of Devonian vs. post-classical Silurian.

In New York, as in Bohemia and the Carinthian Alps, the passage from the Silurian to the Devonian is interrupted by no great defaults, and it really becomes a question of very little moment where, in any country, such a line is to be drawn. With increasing knowledge of the fossil contents of the earth, we may look forward to a cementing of the breaks in the record of organic succession which are now conventionally represented by lines, or planes, or stories in the house of life, as with the rapidly increasing additions which every year brings to our knowledge of fossil organisms, it becomes more and more difficult to adhere to any conventional system of classification. The essential point is to determine when and under what circumstances of sedimentation and association organic types of generic or broader value have appeared, what has been the mode of development, variation and extinction of such types, and what the history of the fauna; how modified by migration, by changes in sedimentation or depth of sea bottom.

In turning our attention briefly to the consideration of what American fauna comprehends the strongest alliances with the Hercynian or lowest Devonian pelagic fauna, it is necessary to notice the important observations on this point by all the principals in the Hercynian discussion. Reference to these has been intentionally left to this place.

We have just noticed that Barrande considered the Upper Helderberg as a Silurian fauna, the nearest equivalent of his faunas F, G, H, especially of G. Beyrich (1867), in suggesting the Devonian age of the lower Wieda limestones and the possible equivalence to the Bohemian F, G, H, extended the parallel to the calcareous facies of the "Helderberg Division" of New York. Kayser (1878), in his description of Hercynian species, made many identifications and comparisons which it is essential here to notice in detail.

Trilobites. To the group of *Dalmanites Hausmanni* are referred:

D. pleuroptyx	L. H.		D. myrmecophorus	U. H.
D. micrurus	L. H.		D. Helena	U. H.
D. tridens	L. H.		D. Calypso	U. H.
D. nasutus	L. H.	?	D. Erina	U. H.
D. tridentiferus	L.H.	?	D. acanthopleurus (=myrmecophorus)	U. H.
		?	D. denticulatus	S. G.
		?	D. emarginatus	S. G.

D. Beyrichi, Kayser, to the group of D. pleuroptyx.

Cryphæus calliteles? This identification appears to us open to serious question.

Cephalopoda. Goniatites evexus (generally diffused through Lower and Middle-Devonian) including G. expansus (Ham.) aff. G. mithraci.

Orthoceras? lamelliferum, cnf. Cytoceras eugenium, U. H.

Hercoceras? subtuberculatum, cnf. Gyroceras paucinodum, U. H.

Gastropoda.

Capulus Hercynicus, var. Selcanus, aff. Platy. pyramidato, U. H.

var. Bischofi, aff. Pl. platystomati, L. H.

var. acuta, aff. P. elongato et plicato, L. H.

C. uncinatus, cnf. P. symmetricum, U. H., Ham.

C. Zinkeni, aff. P. carinato, U. H., Ham.

C. Halfari, cnf. P. retrorsum, L. H.

Platystoma Giebeli, aff. Platycerati Billingsi, L. H.

Pl. naticoides, cnf. Platyceras Gebhardi, L. H., Orisk.

Euomphalus sp., cnf. E. planodiscus, Ham.

Lamellibbranchiata.

Cardiola? megaptera, cnf. Panenka robusta, Portage (?!).

Cypricardinia lamellosa?, L. H.

Goniophora sp., cnf. G. rugosa., Ham.

Pterinea sp., cnf. Pt. textilis, L. H.

Brachiopoda.

Meganteris (?) sp., aff. Rensselaeriæ Johanni, U. H.

Group of Spirifer plicatellus, Sp. macropleura, L. H.

Sp. sericeus, aff. Sp. fimbriato, U. H., Ham.

Sp. Decheni, aff. Sp. cultrijugato, U. H., H.

Sp. Ilsae, cnf. Sp. arrectus, Orisk.

Sp. Hercyniæ, cnf. Sp. perextensus, U. H.

Sp. Bischofi, cnf. Sp. Grieri, U. H.

Sp. aff. crispo.

Sp. Jaschei, cnf. Sp. perlamellosus, L. H., raricosta, U. H.

Cyrtina heteroclita, cnf. C. Dalmani, L. H., C. rostrata, O., C. crassa, U. H.

Retzia? lepida, cnf. Leptocoelia imbricata, L. H., acutiplicata, U. H.

Orthis orbicularis, aff. O. planoconvexæ, L. H., O.

O. striatula, cnf. O. multistriata, L. H.

Strophomena rhomboidalis.

S. corrugatella, aff. S. Patersoni, S. G., U. H., varistriatæ, L. H.

S. Jaschei, cnf. S. hemisphærica, S. G., U. H.

Streptorhynchus devonicum, cnf. Orthis deformis, L. H.

Polypi.

Chætetes undulatus, cnf. Ch. tabulatus, U. H.

Emmonsia? cnf. hemisphœrica, analog. Fav. Emmonsi, U. H.

The value of the foregoing comparisons is much obscured in citing them with this brevity, for every palæontologist knows how easy it is to point out similarities in species even of widely different age. Of much additional importance are Kayser's comparative observations on the Hercynian and American faunas (pp. 274–279).

"The Niagara limestone has long been the recognized equivalent of the Gotland limestone, and the Bohemian étage E."

"The water limestones overlying the Salt group contain *Pterygotus* and other great crustacea and on this account were regarded by Murchison as the equivalent of the Tilestones, the cap-formation of the English Silurian." (Quart. Jour., 1855, p. 24.)

"In the overlying Lower Helderberg group we encounter Trilobites of the genera Lichas, Phacops, Homalonotus, Cheirurus [?], Calymene [?], Acidaspis, Proetus, Encrinurus [?] and Dalmanites. With the exception of Encrinurus all are genera with which we are familiar in the Bohemian and Hartz Hercynian, and as for the Dalmanites they all belong to the group of D. pleuroptyx, a form most closely related to the species so important in the European Hercynian, D. Hausmanni. Genuine Silurian types, like Ampyx, Illænus, Asaphus, etc., fail. The Cephalopods afford no notable features. Ascoceras, a genus still extant in the Niagara, is here extinct. Among the Brachiopods there are still many points of attachment to the Niagara, but no longer any genuine Silurian types. On the other hand, besides the first of the Terebratulidæ (Rensselæria, which reaches a culmination in the Oriskany sandstone) are long-winged Spirifers (perlamellosus, cyclopterus, concinnus). A most noteworthy feature among the Gastropods is the enormous development of the Capulidæ (yet but rarely represented in the Niagara), Platystoma, Platyceras, Strophostylus, etc., as the predominance of Capulids forms one of the chief characters or peculiarities of the European Hercynian fauna, and this common character is rendered all the more forcible as we find among the American Capulids, a number of forms which show a similarity to those of the Hartz. The occurrence of numerous Pterineas and entire layers filled with Tentaculites are features which certainly point to the Devonian rather than to Silurian. The same is true of the genus Michelina among the Corals, and Polypora among the Bryozoa, while on the other hand, the comparatively abundant Cystideans remind one of the Silurian. And, finally, it is to be noticed that a very considerable number of species both of Brachiopods and Gas-

tropods pass into the overlying formations, especially the Oriskany sandstone, while others are represented in this formation by analogous forms. If the fauna of the Lower Helderberg reveals close alliances with our Hercynian, those of the overlying formations bear still stronger affiliations.

"In the immediately following thick arenaceous deposits of the Oriskany, Cauda-galli and Schoharie grit (the last of which does not exist in Canada), the similarity with the Hercynian is not so clearly evident as in the overlying limestones, and indeed from their wholly distinct petrographical character nothing else is to be expected. Nevertheless this similarity can not be overlooked and the Devonian character here is still more clearly developed than in the Lower Helderberg. In the Oriskany sandstone, besides the first fishes, appear large, coarse-ribbed, broad-winged Spirifers of true Devonian habit; also species with simple or dichotomizing ribs, related to the well-known *Sp. aperturatus* and *Verneuili* (*arenosus*, Conr.), a considerable number of Rensselaerias and another genus of Terebratulids, Centronella; further, numerous great species of Pterinea, and Orthis? hipparionyx, that is, forms which indicate a Devonian fauna of the general expression of our Rhenish Spiriferensandstein fauna. An Hercynian cast is given to this Oriskany fauna by the contemporaneous existence of Dalmanites of the *pleuroptyx*-group, Calymene Blumenbachi, and a number of Capulids. In the Schoharie grit, in addition to the forms named is, on one hand the Devonian genus Gyroceras, on the other a Trochoceras.

"Finally, in regard to the Upper Helderberg group, we here also encounter a Devonian fauna, just as undoubtedly allied to our Hercynian. The Devonian character is expressed in the appearance of the genus Cryphæus, by Gyroceras and ornamented Cyrtocerata, by the first representative of the Goniatites (*mithrax*, Hall, of the group of *Simplices*), by the Brachiopod fauna, in which, besides the Devonian Spirifers of the Oriskany, are numerous Terebralutid genera (Rensselæria Terebratula, Centronella Cryptonella), a Camarophoria, and several species of Productus; by the coral fauna with Calceola, Michelinia, Pleurodictyum (?), Heliophyllum, Phillipsastræa, etc., and besides, a great number of species in common with, or analogous to those of the Hamilton shale. On the other hand, the relation to the Hercynian is demonstrated in about a dozen great Dalmanites which again belong essentially to the *pleuroptyx*-group, by a great Calymene, allied to *Blumenbachi*, a half-dozen species of Trochoceras, and Hercoceras (?), several great species of Nautilus suggesting forms from the Bohemian étage E., Dictyograptus (*splendens* Billings) and

mass of Capulids, which again show many affiliations with the Hartz and Bohemian species."

From the foregoing (making suitable allowance, in some of the comparisons, for the progress of knowledge since the date of this writing), it appears that both the Lower and Upper Helderberg groups, and to a certain degree the arenaceous deposits separating the two, enclose faunas which are closely allied to those of the oldest formations of the Hartz and their equivalent series of beds in Bohemia.

Moreover, the American faunas in question demonstrate that in all their leading features they are Devonian, more strongly so the higher we ascend, although in occasional particulars, like the European Hercynian faunas, they reveal many peculiarities suggestive of Silurian characters.

In 1884, Kayser, having altered his view in regard to the base of Bohemian Devonian, paralleled the Lower Helderberg with F_2, the Oriskany and Upper Helderberg with G, placing the Waterlime and Tentaculite limestone as the equivalent of the Ludlow, parallel to F_1.

Novak having shown in 1880 that the étage F was not divisible except in to varying facies of one fauna, Frech, in 1887, regarded the Waterlime as equivalent to E_2 (Ludlow, Up. Sil.), the remainder of the Lower Helderberg and the Oriskany as different facies of the same horizon ($=F_1+_2$, lowest Lower-Devonian), the Cauda-galli and Schoharie grit as the upper part of the Lower-Devonian the Corniferous as lower Middle-Devonian, the Upper Helderberg group generally, being the essential equivalent of the Étage G, G_2.

Barrois's (1889) description of the Erbray Hercynian fauna gave rise to the following comparisons with American species:

Brachiopoda :

Strophomena hercynica, aff. S. varistriatæ, L. H.
Ambocoelia umbonata, Conrad, cf. Sp. modestus, L. H.
Orthis palliata, Barr., aff. Orth. pereleganti, L. H.
O. striatula, Schl., aff. O. multistriatæ, L. H.
O. vulvarius, Schl., aff. O. multistriatæ, L. H.
O. Tulliensi, Ham.
Pentamerus Sieberi, Buch., cnf. Pentam. Verneuili, L. H.
Pentamerus galeatus.
Rhychonella amalthoides, Barrois, cnf. R. acutiplicata, L. H.
R. nympha, Barr., aff. R. Campbellanæ, L. H.
R. cognata, Barr., aff. R. bialveatæ, L. H.
R. princeps, Barr., cnf. R. mutabilis, L. H.

Atrypa reticularis, Var. A., L. H.
Var. B (rare), U. H.
Bifida lepida, aff. Leptocœliæ imbricatæ, L. H.
Leptocœliæ acutiplicatæ, U. H.
Meristella Circe, Barr., cnf. M. arcuata, L. H.
M. Haskinsi, Ham.
Merist. lata, Barrois, not Hall, cnf. Rensselæria lævis, L. H.
Merist. biplicata, Barrois, cnf. M. nasuta, U. H.
M. lævis, U. H.
Athyris concentrica, Buch, aff. A. spiriferoidi, Ham.
A. subconcentrica ?, DeVern., aff. A. coræ, Ham.
Cyrtina heteroclita, Defr., aff. C. Dalmani, L. H.
C. rostratæ, Orisk.
Spirifer Decheni, Kay., aff. Sp. acuminato, U. H., Ham.
Sp. subsulcatus, Barrois, cnf. Sp. macropleurus, L. H.
Sp. arrectus, Orisk.
Sp. fimbriatus, U. H.
Sp. cnf. Nerei, Barr. var. cnf. Sp. Mannï, U. H.
Sp. Trigeri, DeVer., cnf. Sp. Grieri, U. H.
Sp. Jaschei, Roem., cnf. Sp. raricosta, U. H.
Centronella ? Œhlerti, Barrois, aff. Cryptonellæ rectirostra, Ham.
Centronella ? Juno, Barrois, aff. Meristellæ bellæ., L. H.
Crania occidentalis, Barrois, cnf. Cr. gregaria, Ham., C. Leoni, Chemung.

LAMELLIBRANCHIATA:

Conocardium Marsi, Œhlert, cnf. C. nasutum (?).
C. nucella, Barr., cnf. P. alternatum.
C. Œhlerti, Barrois, cnf. C., normale.

GASTROPODA:

Platyceras Selcanum, Giebel, aff. P. pyramidato, L. H.
P. inequilaterale, Barrois, cnf. P. platystomum, L. H.
P. plicatum, L. H.
P. Protei, Œhlert, aff. P. calantico, L. H.
P. obeso, L. H.
P. acutum, A. Roem, aff. Pl. elongato, L. H.
P. contortum, Barrois, aff. P. Billingsi, L. H.
P. trilobato, L. H.
P. verrucosum, Barrois, aff. P. nodoso, U. H. (S. G.).
P. undato, U. H.
P. (Strophostylus) naticoides A. Roem, aff. S. Fitchi, L. H., cnf., P. Gebhardi, L. H.

P. (S.) orthostoma, Barrois, aff. P. turbinato, U. H.
P. (S.) naticopsis, Œhlert, aff. S. globoso, L. H.
P. (S.) Giebeli, Kays., cnf. P. Billingsi, L. H.
P. trilobatum, L. H.
S. Fitchi, L. H.
Cyclonema Guillieri, Œhl., cnf. C. Doris, S. G.

Trilobites:

Proetus fallax, Barr., cnf. P. Rowi, Ham.
P. Ligeriensis, Barrois, aff. P. curvimarginato, S. G.
P. cornutus, Gold., aff. P. canaliculato, U. H.

This striking array of specific affiliations involving suggestions of analogy or identity in nearly twenty-five per-cent of the Erbray species with American forms and the great majority of these with Lower Helderberg species, circumstances similar, though actually much stronger than those which had induced Kayser and his followers to refer the Lower Helderberg fauna to the lowest Devonian, has not led Barrois to the same conclusion. On the contrary, in the face of this showing, he is disposed to regard the Erbray fauna as parallel to the Hercynian and étage G, the Oriskany and, in part, the Upper Helderberg, standing as equivalents thereof, while the étage F, with the Lower Helderberg as its parallel, is relegated to the top of the Silurian. The Waterlime is incidentally considered as a distinct fauna equivalent to the Tilestones.

In this respect the author appears to us (irrespective of personal convictions in regard to the validity of all the data) not to have fully faced the facts and indeed his somewhat different position, assumed on page 319, appears in a certain degree more harmonious. There it is held "that the three étages Konieprusian, Gedinnian and Coblenzian constitute the passage between the Upper-Silurian and the Lower-Devonian;" (the Konieprusian equaling F = Lower Helderberg, the Gedinnian, G = Oriskany = Upper Helderberg, *partim* = Hercynian = Erbray, the Coblenzian, H = Upper Helderberg *partim.*)

The reasons for this conclusion, to us at least, are somewhat obscure, as we find in the matter of detailed specific analogies and faunal ensemble, closer analogy in the calcareous Hercynian of the Hartz and Erbray, and the Lower Helderberg, than in those faunas and that of the Upper Helderberg. Furthermore, the suggestion of Barrois, that the Oriskany and Upper Helderberg (i. e. essentially Corniferous) faunas stand in the same relation to each other as the quartzite of Plougastel and the Erbray limestones, i. e. arenaceous and calcareous facies of the same faunal assemblage, will not afford complete satisfaction.

With the foregoing notes upon the opinions of European palæontologists in reference to the age and equivalence of the Helderberg faunas of New York, we may turn to a brief consideration of their predominating faunal characters. It is necessary to remark, in a preliminary way, that the conception generally held by American geologists, of the Lower Helderberg as a Silurian fauna, by implication signifies that it is of post-, or supra-classical-Silurian age, in precisely the sense entertained by Barrande for the Bohemian F, G, H. That the Wenlock and Niagara faunas are essential equivalents will not be seriously questioned. Neither will there be efficient objection to the separation from the typical Lower Helderberg fauna, of what is customarily regarded as its basal member, the Waterlime. The reference of this formation to the Onondaga Salt Group is in accordance with the views of Prof. Hall expressed in 1859 * and it has been shown by S. G. Williams † that in the Cayuga Lake section, the Waterlime is complicated lithologically with the upper layers of the Salt Group, and inseparable from them, while an overlying series of impure limestones contains a meager representation of Lower Helderberg species.

The characteristic fauna of the Waterlime, viz., Merostomatous Crustacea, which flourished under the conditions prevailing during the age of the Salina, with its land-locked seas and salt-marshes, demonstrates its equivalence with the upper Ludlow and the Tilestones, with which the English Silurian is closed, and we may quote Murchison's observation, to the effect that "wherever these large crustaceans are found, and with them small Lingulæ and other fossils, we may be sure that we are at or very near the summit of all rocks to which the term Silurian can be applied, and that the next overlying stratum belongs to the first great era of fishes, the Devonian or Old Red Sandstone."‡.

For the purposes of the present occasion, the faunas of the Lower Helderberg in their typical development may be considered in their entirety. Indeed, the subdivision of the fauna is essentially a variation in facies accompanying the change in condition and quality of sedimentation. This subdivision either of faunas or strata becomes more obscure the further one departs from the region of typical exposures.

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* Palæontology of N. Y. vol. 3, p. 387.

† Sixth Ann. Rept. State Geologist N. Y. p. 10, 1887.

‡ Quarterly Journ. Geol. Soc. Vol. xii, p. 24.

Faunal Characters of the Lower Helderberg.

POSITIVE ELEMENTS.

C The Crustacean element is, for the purposes of a diagnosis, of the first importance. The Trilobitic genera present are *Homalonotus, Bronteus, Dalmanites, Phacops, Acidaspis, Lichas, Proëtus, Phaethonides* and *Cyphaspis.*

The single species of *Homalonotus* (*H. Vanuxemi*) possesses the strongly annulated pygidium characterizing the earlier representatives of the genus (e. g., *H. delphinocephalus* of the Niagara, H. *major* of the Oriskany), and in this respect is in strong contrast to the latest members of the genus, with obsolete pygidial ribs. On the other hand the species presents the smooth unlobed glabella of the prevalent *H. De Kayi* of the Hamilton, and therein indicates a progress from the Silurian type of *Trimerus* to the Devonian *Dipleura.*

Bronteus Barrandii, and the allied form, *B. Pompilius* from the Square Lake (Maine) fauna, are species with comparatively small pygidia having a simple, unbifurcated median rib; representing a group prevailing in the Lower-Devonian faunas of Europe. The margins of the pygidia are smooth, not spinous as in the subdivision *Thysanopeltis,* a strictly Devonian group.

The abundant representatives of *Dalmanites* are typical members of a wide-spread, lowest Devonian group, namely, that following the type of *D. Hausmanni* (subgenus *Hausmannia,* Hall). Strictly conformable to this type are the species *D. pleuroptyx* and *D. micrurus.* Also conformable in general expression and the essential features of simple and complete glabellar lobation, are *D. nasutus, D. tridens, D. tridentiferus,* which present ornamental extravagances in the prolongation of the frontal border into a furcate proboscis; also *D. dentatus,* which possesses a serrate frontal border, indicating its close alliance to *D. regalis* of the Schoharie grit and to *D. pygmæus* of the Corniferous limestone, these three species constituting the subgenus *Corycephalus,* Hall, as far as its representation is known. *D. pleuroptyx,* which continues its existence into the Oriskany and Corniferous, has a somewhat explanate crenulated frontal border, indicating the inception of the peculiar dentate frontal ornamentation in the Upper Helderberg subgenus *Odontocephalus.* The remarkable variety of ornamentation in all these trilobites is of itself an important character, irrespective of the genera represented, for it is in Devonian faunas that such features are carried to an extreme. (See Palæontology of N. Y., Vol. VII, *Dalmanites, Bronteus, Ceratolichas, Arges, Terataspis, Acidaspis,* and *Cyphaspis;* also a great number of species of these and other genera in the European Devonian.) It is noteworthy that a

nasute *Dalmanites* (*D. bicornis*) is known to occur in the Niagara fauna at Waldron, Indiana, moreover the characteristic *D. limulurus* of the Niagara, and *D. verrucosus* and *D. vigilans* of the Waldron fauna conform to the *Hausmannia* type.

Phacops is represented by *P. Logani* and *P. Hudsonicus* (probably the same species). These, together with the *P. Trajanus* of the Square Lake fauna, are typical *Phacopes, i. e.* forms in which the glabellar lobes are almost or quite coalesced, the glabella ventricose and the pygidium short. In general this genus divides itself into two groups, in one of which the glabellar furrows are represented by faint linear impressions, and the pleuræ of the pygidium are duplicate; in the other the furrows are obsolete and the pygidial pleuræ simple. The latter is believed to be limited to Middle-Devonian faunas (*P. rana* Hamilton, *P. latifrons*, Eifelian) while the former is widely disseminated as a characteristic Lower-Devonian group, and to this belong all the Lower Helderberg species. Moreover, true *Phacops* is not known in any earlier American fauna.

Of *Acidaspis* we have two species; *A. tuberculata* is so closely related to the Corniferous *A. callicera* that it may prove specifically identical with it. The remarkable *A. hamata*, with long recurved cervical horns, finds its only known analogue, and almost specific identity in the *A. monstrosa*, Barrande, of the étage G.

Lichas is represented by forms belonging to the subgenus *Conolichas*, which finds a later development in the Upper Helderberg. In this group the glabella becomes very tumid and elevated, and in this respect the Lower Helderberg Lichads differ from those of the preceding American faunas (*Platynotus*, etc.). *Conolichas*, however, attains a considerable and more typical development in the European Silurian.

The species of *Proëtus* (*P. protuberans* [*P. Junius*, Square Lake]) are not diagnostic. Their rare occurrence is in sharp contrast to the great development of the genus in the Upper Helderberg, but they conform to the type of structure expressed in the series *P. angustifrons* of the Schoharie grit, *P. clarus* of the Corniferous, *P. Rowi* of the Hamilton, *P. marginalis* (= *P. Rowi*) of the Tully.

Phaëthonides makes its earliest appearance in the Lower Helderberg (*Ph. cyclurus* [*Ph. macrobius*, Square Lake]) and is represented in the Schoharie grit, Corniferous and Hamilton faunas.

Cyphaspis cœlebs (the only species) is allied to both *C. Christyi* of the Niagara and *C. minusculus* of the Upper Helderberg.

Lamellibranchiata. The existence of true Pterineas is not yet demonstrated. The abundant Pterineoids are largely Actinopterias and their prolific development stands in sharp contrast to their com-

parative paucity in the Niagara, while it is in harmony with their abundance in the Devonian. (*Avicula textilis*, *A. communis*, *A. obliquata*, *A. manticula*, *A. securiformis*, *A. pauciradiata*, etc.). *Aviculopecten* has a well-developed representation (*A. tenuilamellata*, *A. spinulifera*, *A. Schoharie*, *A. umbonata*, *A. bellula*).

Mytilarcas of large size and gibbous form, belonging to the Devonian subgenus *Plethomytilus*, are abundant in individuals (*M. ovata*, *M. cordiformis*).

Cypricardinia appears in the subdivision of the genus characterized by distant elevated concentric ridges. This group begins in the Niagara (*C. undulostriata*, *C. arata ?*), is more typically developed in the Lower Helderberg (*C. lamellosa*), the Schoharie grit (*C. planulata*), reaches a culmination in individual development in the Corniferous and Hamilton species (*C. indenta*), and is continued to the Chemung (*C. arcuata*) and even into the Lower Carboniferous (*C. consimilis*).

Ilionia (*sinuata*) is known only here and in the Corniferous limestone.

Conocardium has but a meager representation in the single rare species *C. inceptum*. This genus is but sparingly known in Silurian faunas.

A large species of *Modiomorpha* (*M. oblonga*); undescribed species of of the genera *Grammysia*,* *Goniophora*,* *Paracyclas*,* *Lunulicardium*,* (!) are also known.

There are no indubitably præ-Devonian types in this element of the fauna.

GASTROPODA. This group is characterized by an immense development of the genus *Platyceras*, which has been but sparingly represented in the Silurian faunas, but has attained a great abundance in species in the Oriskany, Upper Helderberg and Hamilton. The prevalence of these forms is one of the most striking characters of the Hercynian fauna. The type *Orthonychia* attains its culmination in the Lower and Upper Helderberg; the nodose species, which become abundant in the Oriskany and Corniferous, are represented, while the lamellose species and the ventricose, Platystomoid forms are predominant. The spinose group prevailing in the Corniferous and Hamilton has not been observed here. Noteworthy is the occurrence of a species (*P. perlatum*) bearing the characters of KAYSER's Hercynian genus, *Hercynella*.

The genera *Strophostylus* and *Platystoma* have both more abundant representations in earlier and later faunas, and are not diagnostic.

Loxonema, a post-Silurian type, is of infrequent occurrence. The naticoid genus *Holopea* is represented by a variety of species. This

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*These are represented in the collection of Mr. C. E. Beecher and that made by the writer, the latter now the property of Mr. Charles Schuchert.

genus is well developed in the Silurian and may be considered as a forerunner of the more abundant naticoids of the Devonian and Carboniferous.

Brachiopods. The Orthids attain an important development both individually and specifically. The abundance of *Orthis* is itself suggestive of Silurian faunas; moreover, the types of *O. elegantula* and *O. hybrida* are represented, the former by *O. planoconvexa, O. subcarinata*, the latter by *O. discus*, etc. These types are continued into the Devonian with a feebler representation, e. g. *O. lenticularis*, Upper Helderberg, *O. lepida*, Hamilton.

The abundant *O. oblata* marks the inception of a characteristic Devonian group, that of *O. Vanuxemi*, in which valves are large, subcircular, subequiconvex, the muscular impressions flabellate (*O. musculosa*, Oriskany, *O. peloris*, Schoharie grit, *O. Livia*, Corniferous, *O. Vanuxemi, Penelope, leucosia, idoneus*, Hamilton, *O. subcordiformis* Eifelian).

Orthis varica (*Dicœlosia*) is a Silurian type. *Scenidium* (*insigne*) is a rare form occurring in about equal development in both Niagara and Middle-Devonian faunas (*Mystrophora*, Eifel).

The Strophomenoids (*Strophomena rhomboidalis, Strophodonta, Strophonella*) are very abundant and much diversified. Their development is in harmony with their great representation in the Upper Helderberg and Hamilton. It is possible to trace various features in this group which attain characteristic development in either Silurian or Devonian faunas; e. g. the abundance of reversed Strophomenas (*Strophonella*), (Silurian); of true *Strophodonta* (Devonian); flat species of the group of *Strophodonta perplana* (Devonian); convex forms with full, rounded umbones (Devonian); convex forms with flat umbonal regions and anterior deflection (Silurian). *S. varistriata* has a peculiar undulated ornamentation between the radiating lines, a feature reproduced in the *S. Patersoni* of the Upper Helderberg. *Streptorhynchus* of typical character, with high, often distorted ventral beak, makes its first appearance in the species *S. deforme*.

Chonetes is represented by two undescribed species,* one a large flat form very closely similar to the Oriskany species, *C. complanata*, belonging to the group of *C. syrtalis* (Devonian); the other a small, convex species, belonging to the extensive Devonian group including *C. lineata, scitula, lepida, deflecta*, etc., etc.

The Spirifers constitute a striking feature of the fauna, their abundance and variety being in great contrast to their comparative paucity in the Niagara. In *S. perlamellosa* we have the first of the

*In the collection of Mr. Schuchert.

distinctly septate Spirifers, which are represented in the Upper Helderberg by the closely allied *S. raricosta*, in the Hamilton by *S. zic-zac* and *S. sculptilis*, all in the line of development toward *Spiriferina*. The post-Silurian long-winged group is represented by the same species. In *S. perlamellosus* again, and in *S. cycloptera* and *S. concinna* we find a strongly lamellose ornamentation which has its inception in the Niagara *S. sulcatus*, but is represented in the Devonian by an abundance of forms e. g. *S. submucronatus, Cumberlandiæ, tribulis, arrecta*, of the Oriskany, *S. raricosta, duodenaria*, of the Upper Helderberg, *S. mucronatus, zic-zac, sculptilis*, Hamilton, etc. The lamellose forms of the Lower Helderberg retain evidence of Silurian relations in the fine interrupted striæ on the lamellæ, a feature also seen in *S. arrecta* of the Oriskany and *S. raricosta* of the Upper Helderberg, but not usually present in the more numerous Devonian species. *S. macropleura*, with its finely lineate surface, follows more closely the Silurian type of *S. plicatellus* and *S. Niagarensis*, presenting, however, a deviation therefrom in its few great ribs. This lineate type is not known in the American Devonian, but is represented in the European Lower-Devonian by *S. Davousti* and others. The smooth unribbed non-fimbriate type of *Martinia*, essentially Carboniferous in its culmination, is represented by *S. modestus*, which may be regarded as its earliest member. *Cyrtina Dalmani*, together with *C. rostrata* of the Oriskany, (?) *C. biplicata* of the Schoharie grit, *C. crassa* of the Corniferous and *C. Hamiltonensis* and var. *recta* of the Hamilton, represents a series of unessential variations, which in European faunas pass under the name of *C. heteroclita*, Defrance, and its varieties, *multiplicata* Davidson and *lævis*, Kayser, forms ranging from the Lower into the Middle-Devonian and common in the Eifel, Belgium, France and England. The variations of *C. Dalmani* are most closely those of the Hamilton species. The genus is not represented in the Silurian.

Trematospira is represented by several species, one of which (*T. multistriata*) is of very considerable size and closely related to the Hamilton *T. hirsuta*. All are in contrast to the few small species of the Silurian.

Nucleospira is well developed in both Silurian and Devonian faunas. The species of the former (*N. pisum, pisiformis*) are small and rotund, while those of the Devonian are larger and less convex (*N. concinna*). Both groups are represented in the Lower Helderberg, the former by *N. ventricosa*, the latter by *N. elegans, concentrica*. Of the Meristoids, no true *Meristina* or *Whitfieldia* is known to occur in the group. *Merista* is represented by two species in the Maryland fauna, and aside from these it is probable that all the abundant meristoids of the fauna

belong to the genus *Meristella,** in which the loop is produced at the union of its arms into two circular branches, while in *Meristina*† and *Whitfieldia* of the Niagara, the loop terminates in a short, sharp, simple process, or in a blunt, bifurcate extension. In this progressive complication of the loop, the simplest forms are limited to the earlier faunas.

The development of *Rensselœria* appears to be of essentially Lower-Devonian import. The genus attains its greatest development in the Oriskany and appears only sparingly thereafter, while it is not known to occur in the Niagara. Another Terebratuloid genus similar to, if not identical with *Cryptonella,* is also known in the Lower Helderberg. The development of *Pentamerus* in the American and European palæozoic is essentially different. For example, *P. galeatus,* which is confined to the Lower Helderberg, is limited in England to the Upper-Silurian, but in Germany passes upward into the lower Upper-Devonian, subject to some, but unessential, variations. Again, the genus, under its strict limitations, is, in America, almost exclusively confined to Silurian faunas, while on the continent of Europe, large, coarse-ribbed species are distributed throughout the Lower-Devonian. The phenomenon is precisely the reverse of that presented by the genera *Goniatites* and *Cryphœus,* which, in the Continental Devonian put in an earlier appearance and attain a much greater specific development than here.

Anastrophia is known only in the Lower Helderberg and Niagara faunas.

Rhynchonella is extremely prolific in species, but can hardly be said to present diagnostic features, save in the obese forms, *R. mutabilis, pyramidata, ventricosa,* which have a Silurian expression.

Eatonia is limited to the faunas of the Lower Helderberg and Oriskany.

Pteropoda. *Conularia,* usually a rare form in the Silurian, was comparatively abundant (*C. pyramidalis*).

Tentaculites is extremely abundant, often constituting entire layers

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*That is, *Meristella* in its current acceptation, or with the internal structure as in *M. arcuata* and as described by Prof. Hall in 1867 (Pal. N. Y. Vol. IV, p. 298). The first type of the genus, the species for which the name was proposed in 1858 (12th Rept. N. Y. State Cab. Nat. Hist.) is *M. naviformis* of the Clinton group, and the precise character of its loop is not yet understood. In the second use of the term (13th Rept. State Mus., p. 73), where the genus is defined, it is evident that the group is based on the *Atrypa tumida* Dalman., subsequently used by Davidson as the type of his genus *Whitfieldia.*

†Also in its current signification. The type of this genus was *M. Maria,* regarded by Davidson, with undoubted accuracy, as identical with Dalman's *Atrypa tumida,* and therefore referred to his *Whitfieldia.* It thus appears that *Atrypa tumida* has been taken as the type of two, if not of three, distinct genera.

(Tentaculite limestone) as do *Styliolina* and the same genus in the Devonian.

CEPHALOPODA. The representation of this group is very meager and a contrast to the other elements of the fauna. The genera represented are *Orthoceras*, *Oncoceras* and *Cyrtoceras*. Of the first, the species are both smooth and annulated, but can not be said to present distinctive diagnostic features. *Oncoceras* is a Silurian genus and is of extremely rare occurrence in the Lower Helderberg. The little-known species of *Cyrtoceras* are not diagnostic.

CRINOIDEA. These show, as a whole, strong Silurian affinities, seen in the great abundance of Cystidians of various genera, and of species of *Homocrinus*. The genera *Mariacrinus* and *Edriocrinus* have representatives in the Devonian (Oriskany Upper Helderberg), but none in Silurian faunas. It is important to observe that the Crinoids are of rare occurrence in the typical exposures of the formation, most of the genera and species being known from the western extension of the rocks in central New York, where the thickness of the beds has considerably diminished and the underlying Waterlimestone is well developed. The majority of the species are from the lower beds of the group. The Cystidians (*Anomalocystites*) and *Homocrinus* are represented in the Oriskany, the latter also by several species in the Hamilton.

BRYOZOA. The predominant features of this group are the considerable development of *Fistulipora*, *Lichenalia*, *Polypora* and *Ptilopora*, expressing an emphatic harmony with the Bryozoan elements of the Upper Helderberg and Hamilton; while *Diamesopora*, *Callopora*, *Rhinodictya* may indicate Silurian affinities.

CORALS. The individual abundance of the explanate Favositidæ is in accordance with the great development of reef-corals in the Upper Helderberg and Hamilton. *Aulopora* (four species) and *Striatopora* both attain their culmination in the Devonian. *Michelinia*, a genus abundant in the Upper Helderberg and Hamilton, here makes its first appearance. Cyathophylloids are exceedingly rare in species though *Zaphrentis Rœmeri* is very abundant in individuals.

The Absence of Types.

NEGATIVE ELEMENTS.

Among the Crustacea, the Silurian genera *Ampyx*, *Illaenus*, *Asaphus*, *Calymene*, *Staurocephalus*, *Encrinurus*, *Bathyurus*, *Sphærexochus* are absent. The Devonian subgenus *Cryphaeus*, which, in Continental faunas, ranges from the base to the middle of the Devonian, is wanting.

In America this group has but a meager representation in the Upper Helderberg (one very rare species), but in the Hamilton it attains great individual abundance.

Of the Cephalopoda the genera *Ascoceras, Lituites, Actinoceras, Ormoceras, Streptoceras* have no representatives. No form of *Gomphoceras* is present, either those of Devonian character with simple aperture, or the Silurian forms with the aperture constricted (*Pentacoceras, Hexacoceras*, etc.). *Goniatites* is absent. This Devonian genus appears first in America, in the *Tornoceras Mithrax* of the Upper Helderberg. The representation of the genus throughout the American Devonian is extremely meager when compared with its development in the German Devonian, where it ranges through the entire formation with an almost endless series of specific variations. It is, therefore, evident that with the imperfect development of both *Goniatites* and *Cryphœus* in our faunas, no such diagnostic value can be assigned them as in faunas where conditions have favored their increase and diversity.

Among the Lamellibranchs, the genus *Ambonychia, Anomalodonta, Tellinomya, Clidophorus* and probably *Modiolopsis* are wanting.

Of the Brachiopods, the peculiar group of the Trimerellidæ became extinct in the Niagara and Guelph fauna, (*Trimerella, Monomerella, Dinobolus, Rhinobolus*). No representatives of *Eichwaldia, Streptis, Zygospira, Whitfieldia, Rhynchotreta* or *Platystrophia* have been found.

The foregoing data assuredly indicate a striking development in the typical Lower Helderberg fauna, of organic groups, which in their culmination are characteristic of the Devonian. This consists not merely in the inception here of Devonian types. It is generally true that any fauna embodies various forecasts of those to follow. But in addition we meet here certain climacteric features of critical value, demonstrating equivalence with faunas whose age may be considered now as well established. For example, the development of *Dalmanites* (*Hausmannia*), the Platyceratidæ, *Phacops* of the type of *P. fecundus*, etc., as in the Hercynian of the Hartz and Erbray. Notwithstanding the absence of the strong Devonian types *Cryphœus* and *Goniatites*, these Hercynian characters are endorsed and supplemented by the inception or broader development of characteristic Devonian groups.

The Silurian cast of the fauna is, however, still maintained, with fully as much force in negative as in positive characters, and this is certainly in harmony with our expectations in the case of a fauna which can not be paralleled with the typical development of those

in closest proximity to it. The Cystidians afford perhaps the most positive Silurian feature of the fauna, and we should not underrate its importance. It has already been observed that Kayser's Hercynian contains a *Graptolite* faunula, affording a still more ancient expression than do the Cystidians in the Lower Helderberg, and we may perhaps safely consider this element in the same light as Kayser has these Graptolites, not as necessarily compromising the Devonian cast of the fauna, but as emphasizing its extreme Devonian age. At the same time the fact must not be overlooked that Cystidians do occur in faunas conceded to be Devonian.

In matter of species, it is believed that none pass over from the Niagara fauna to that of the Lower Helderberg save the cosmopolitan forms *Strophomena rhomboidalis* and *Atrypa reticularis*. Affinities of this character are far more pronounced between the Lower Helderberg and the Oriskany.

In the typical localities of the Lower Helderberg in Albany county, the Oriskany sandstone has a very meager development. As the Lower Helderberg limestones diminish in thickness, the overlying Oriskany sandstones increase, and the relative development of the faunas corresponds thereto. This is true wherever the two formations can be traced. In the Southwestern Appalachians at Cumberland, Md., the faunas, are to a large degree commingled, at all events a very considerable per-centage of the New York Lower Helderberg species is embodied in the Oriskany fauna. Though this is to a less degree the case in the New York development of these faunas, there is, in the broader faunal characteristics, a much more intimate homogeneity than will be found between the Lower Helderberg and the Niagara. We may instance the genera *Homocrinus*, *Mariacrinus*, *Edriocrinus* among the crinoids, *Anomalocystites* among the cystidians; *Orthis* * of the *O. Vanuxemi* group; abundance of large Strophodontas; Eatonias, *Cyrtina* of the group of *C. heteroclita;* Spirifers with faintly lineate varices; typical Meristellas; abundant Rensselærias; among the Lamellibranchs, great Actinopterias; of the Gastropods, an immense development of *Platyceras* and *Strophostylus*; *Phacops* with duplicate pygidial ribs; *Homalonotus* of the type of *H. Vanuxemi*, and the occurrence of *Dalmanites pleuroptyx*.

It is not necessary to enter into detailed argument, or to adduce data to demonstrate the Devonian character of the Oriskany fauna. It was assigned to the Devonian by Profs. Hall and De Verneuil in 1845 and it will unquestionably maintain its position as such.

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* Prof. Hall observed in Pal. N. Y., Vol. 3, p. 406, that the similarities in the brachiopods of the two faunas were very close, those of the Oriskany being generally of larger size.

The preceding remarks are made without pretension of elaboration. To establish beyond question the quantivalence of the Lower Helderberg faunas will require a careful revision of its entire representation, not only in its typical development but wherever else equivalents are believed to occur. Coupled with this should be a careful stratigraphical study of superposition and interlamination. What has been here written is intended to be only suggestive, and the inquiries to which it should give rise are:

(a) Is the normal Lower Helderberg fauna, by virtue of predominant Devonian characters, to be referred to the Devonian system?

(b) Is it the American equivalent of the European Hercynian, i. e. an earliest Devonian calcareous pelagic fauna?

(c) Is it the pelagic fauna, of which the Oriskany Sandstone includes the arenaceous facies?

On a Locality of Flint Implements in Wyoming County, N. Y.

By Professor I. P. Bishop,
Of the State Normal and Training School, Buffalo, N. Y.

Professor James Hall, *State Geologist:*

Sir.—In conformity with your request, I send herewith an account of the circumstances under which the flint implements recently presented by me to the Museum of Natural History, were found.

The land on both sides of Silver Lake, Wyoming county, N. Y., affords many interesting relics of the Indians who once resided there ; flint arrow-heads, stone axes and mortars are frequently found, and less frequently pipes, flint knives and rude pottery. About 1880, while residing near Silver Lake, I began a careful examination of the fields on the west side and about the outlet, with the purpose of ascertaining the probable sites of old Indian settlements and of collecting specimens of Indian handiwork. This search I prosecuted in my leisure moments until 1885. Whenever a field was plowed, I looked it over carefully, going back and forth in such a manner that no part should escape observation.

In the latter part of October, 1884, while examining in this way a recently sown wheat field on the farm of Mr. George Needham, just east of the point where the outlet leaves the lake, I found two or three imperfectly worked flints, lying together and partially imbedded in the ground. A few minutes digging with a stick increased the number to thirteen. Believing that others were buried deeper, I obtained permission from the owner to investigate further, and on November eleventh, made an excavation at the spot where the others were found. Less than a foot below the surface, imbedded in a very black soil, was a pile of flints numbering 280, and filling, when taken out, a measure of about ten or twelve quarts. The plow had carried some of them a few feet away, but the greater part were within a space of 2×4 feet; two boys afterwards dug over the ground again and found five more, which, with those first discovered, made an aggregate of 298.

These flints, I was at first disposed to regard as of very ancient make, as they were much ruder in shape and finish than those found about the same field. But after having examined this large

number, there seems little doubt that they were never fully completed, but corresponded to what modern workmen call "blanks." In other words, they were pieces of flint, roughly shaped into the desired form and designed to be completed at some future time. None were provided with a shank or other means of attachment to a shaft; some were nearly circular in form ; many were three or four inches long, with the roughest suggestion of a point, while in a few instances, chips, which had nearly the proper shape, were not worked at all. On the other hand, many specimens were carefully worked to a condition where they might be used as heads, with the exception of the broad base, which was always left unfinished. The average size of the specimens in this collection was much above that of the completed points found in the vicinity. No chips or other debris, incident to the manufacture of flint instruments, were found in the excavation or near it, proving, conclusively, that they were not made on the spot. The piles of flint chips found on all plowed fields near the lake, although containing an occasional large piece, do not, in general, contain such fragments as would naturally be made in shaping these blanks. On the contrary, they are rather such chips as would be formed in working the blanks down to the arrow-heads of the usual size. Moreover, chert like that used in making these arrow-heads is not found near Silver Lake, except as drift specimens, and the quantity is too small to furnish any such a number of weapons as the existing remains bear witness to. Bringing any considerable quantity of crude material from Le Roy or Avon, the nearest accessible localities for chert *in situ*, would be a slow and laborious process with any means savages could command. It seems most probable, therefore, that the flints were roughly shaped where material was plenty, presumably at some point on the Corniferous limestone belt near Le Roy, and that the half-completed points were then taken to Silver Lake, where they were finished as they were needed. Possibly, this pile was some warrior's supply of ammunition for a campaign against the enemy, or a winter's hunting, buried for concealment, and forgotten, or abandoned because of some sudden change of location.

Mr. J. W. Chamberlain, who owns the land bordering upon the north end of the lake, informs me that a similar collection of flints was plowed up on his farm a number of years ago. He said there was "about a peck" of them according to the best of his recollection. Unfortunately none of these have been preserved. He described them as being roughly made from a white waxy chert which was almost translucent. Two finely-worked flints of this material were found by me on Mr. Chamberlain's farm and are now in my private

collection. I am not able to give any conjecture as to the source whence this chert was procured.

The accompanying* sketch of Silver Lake and its surroundings shows the localities to which reference has been made in the foregoing pages. The flints which form the subject of this article were found at A; B marks the spot on Mr. Chamberlain's farm where the other deposit was found. All the fields between A and B and for a considerable distance down the outlet are plentifully strewn with flint arrow-heads and the debris of arrow-head making. The land here is dry and its proximity to the lake afforded excellent facilities for hunting and fishing. Here too, was the most natural point for crossing the outlet, the banks being hard and dry upon both sides.

On the west side of the lake, near the spot marked C, there is evidence of Indian residence. Arrow-heads are unusually plentiful; and stone pestles with at least one stone mortar have also been found in that field and in the one adjacent. Flint chips, the refuse of arrow-head manufacture occur here in little piles, the relative position of which is indicated by the dots near C. From the regularity of these chip-heaps I conjecture that they mark the sites of wigwams where arrow-heads were made. This settlement must have been several acres in extent.

Very respectfully,

IRVING P. BISHOP.

State Normal and Training School, Buffalo, N. Y., *Nov.* 6, 1888.

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* The diagram illustrating the position of these flints, in relation to Silver Lake, and to the other points noticed in this paper, was not engraved in time for this report, but will be given in the Report of the State Geologist for 1889.

Catalogue of the Specimens Arranged by Prof. E. Emmons, as Representatives of the Taconic System, in the State Cabinet of Natural History, at the Close of the Geological Survey of New York in 1843.

[Originally published in the First Report upon the State Cabinet of Natural History by the Regents of the University in 1848.]

TACONIC SYSTEM.*

Table Case.

1. Mica slate (containing garnets). Southwest corner of Dover, Dutchess.
2. Mica slate (alum rocks). Three miles south of Ameniaville, Dutchess.
3. Micaceous slate. Taghkanic Falls, one-fourth mile from New York line, Mass.
4. Granular quartz. Hall's Point, two and one-half miles west of Peekskill, Westchester.
5. Compact quartz rock. One mile east of Poughkeepsie, Dutchess.
6. Granular quartz. One mile southeast of Klyne's Corners, Amenia, Dutchess.
7. Quartz rock. Southwest side of Stissing mountain, Stanford, Dutchess.
8. Quartz (with galena). Lead mine, Amenia, Dutchess.
9. Copper ore (in quartz). Northeast corner of Washington, Dutchess.
10. Gneiss. Loose below Harrisville; to be found in place at Garvis, five miles below.
11. Limestone. Stormville, Dutchess.
12. Sparry limestone.
13. Talcy limestone.

14–15. Talcy limestone. Stormville, Dutchess.

16. Talco-slaty limestone. Stormville, Dutchess.
17. Granular limestone. Near iron ore bed, Amenia, Dutchess.

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* In this series the talcose and other slates follow the limestones, this being their ascertained order of superposition.

18. Talcy slaty limestone. Lebanon Springs, Columbia.
19. Magnesian slate. Richmond, Vermont.
20. Granular limestone (white marble). Stevens' quarry, two miles southeast of Dover Plains, Dutchess.
21. Granular limestone. Eastern base Williamstown mountain, Egremont, Mass.
22–23. Granular limestone. Western base of Williamstown mountain range, Hillsdale, Columbia.
24. Clouded marble. East Merrit's farm, northeast, Dutchess.
25. Talcy limestone. Northwest corner of Unionville, Dutchess.
26. Granular limestone. Bounding the iron ore bed on the west, Amenia, Dutchess.
27. Limestone. General Van Cortland's quarry, near Blue Rock, Cortland, Westchester.
28. Limestone (colored by iron). Ore bed, Lewisburgh, Lewis.
29. Impure crystalline limestone. Reamer's ore bed, Lewisburgh.
30. Crystalline limestone (colored by iron). Lewisburgh.
31. Crystalline limestone. Ore bed near Lewisburgh.
32. Limestone. Near Green pond, Lafarge's farm, Harrisville, near the Potsdam sandstone.
33. Slaty limestone. Lead mine, Amenia, Dutchess.
34. Sparry limestone.
35. Hematitic iron ore (stalactitic). Dutchess.
36. Hematitic iron and limestone. Dutchess.
37. Loose materials (consolidated by iron ore). Iron mine, Stockbridge, Mass.
38. Carbonate of iron. Stockbridge iron mine, Mass.
39. Quartz rock or buhrstone. Near Washington, Mass.
40. Specular iron ore. Lafarge's farm, near Green pond, Harrisville.
41. Specular iron ore. Near Green pond, Lafarge's farm, Harrisville, near the Potsdam sandstone.
42. Peroxide of iron. Stirling mine, Jefferson.
43. Peroxide of iron and kakoxene. Stirling mine, Jefferson.
44. Peroxide of iron. Ore bed near Lewisburgh.
45–46. Peroxide of iron and quartz. Iron ore bed near Lewisburgh.
47–48. Carbonate of iron? etc. Near ore bed, Lewisburgh.
49. Iron pyrites, etc. Reamer's ore bed, Indian lake, Lewis.
50. Iron pyrites. Reamer's ore bed, Indian lake.
51. Iron pyrites. Cleveland's, Natural Bridge, Jefferson.
52. Slate. One mile south of Montrose, Dutchess.
53. Slate (hornblendic). Two miles east of Hillsdale, Columbia.

54. Slate (green). One-quarter mile east of Canaan Centre, Columbia.
55. Talcose slate. Southwest side of Canaan gap, Columbia.
56. Slate. One-quarter mile south of Canaan Centre.
57. Talcous slate. General Van Cortland's farm, south end of Gallows hill, one-half mile north-northwest of Peekskill, Westchester.
58. Mica and talcy slate. Bounding the iron ore bed on the east at Amenia, Dutchess.
59. Magnesian slate. Top of Taconic mountain, between Williamstown, Mass. and Petersburgh, N. Y.
60. Slate. Pleasant Plain, Clinton, Dutchess.
61. Green slate. One mile southwest of Washington Hollow, Dutchess.
62. Taconic slate. Petersburgh (foot of Taconic mountain).
63. Green talcy slate.
64. Magnesian slate. Summit Taconic mountain, between Williamstown and Petersburgh.
65. Talcose slate. Summit of Williamstown mountain range, on the line of Massachusetts and New York, Hillsdale, Columbia.
66. Limestone (at its junction with talcous slate). General Van Cortland's quarry, Cortland, Westchester.
67. Magnesian slate. Summit Taconic mountain, between Williamstown and Petersburgh.
68. Slate (at the Hone hill, containing needleform schorl, Williamstown, Mass.
69. Chlorite slate. Stephen Smith, Canaan, Columbia.
70. Chlorite and carbonate of iron (in magnesian slate). Summit of Taconic mountain.
71. Chloritic rock (the silver ore). Cleveland's, Natural bridge, Jefferson.
72. Serpentine. Cleveland's, Natural bridge.

VERTICAL CASE.

73. Limestone (in slate). Hanford, Dutchess.
74. Sparry limestone. Warwick, Orange.
75. Sparry limestone. Unionvale, Dutchess.
76. Limestone (near the slate). Arthursburgh, Dutchess.
77. Sparry limestone (near the slate). Hoosick, Rensselaer.
78. Sparry limestone (slaty). Hoosick, Rensselaer.
79. Sparry limestone. Bloomingrove, Orange.
80. Slaty limestone. Ashford, Mass.
81. Stockbridge marble (crystallized limestone), Dover, Dutchess.

82. White crystallized limestone. Sing Sing, Westchester.
83. Granular limestone (dolomitic). Sing Sing, Westchester.
84. Granular limestone (dolomitic, clouded). Sing Sing.
85. Crystalline limestone. White Plains, Westchester.
86. Crystalline limestone. Redford, Westchester.
87. Granular limestone (blue). Sing Sing, Westchester.
88. Grey limestone (compact). Beekmanville, Dutchess.
89. Clouded slaty limestone. Amity, Orange.
90. Slaty limestone. Verplanck, Westchester.
91. Crystalline limestone. East Chester, Westchester.
92. Crystalline limestone. West Farms, Westchester.
93–94. Crystalline limestone. Kingsbridge, New York.
95. Crystalline limestone. Stanford, Westchester.
96. Granular limestone. Verplanck, Westchester.
97. Granular limestone (bluish). Dover Plains, Dutchess.
98. Crystalline limestone. East Chester, Westchester.
99. Granular limestone. White Plains, Westchester.
100. Limestone (silicious and gneissoid). Adams, Massachusetts.
101. Limestone with talc. New Ashford, Mass.
102. Chert in limestone. Williamstown, Mass.
103. Granular limestone (yellow). Williamstown, Mass.
104. Milky quartz (in limestone). Williamstown, Mass.
105. Granular limestone (marble sawn slab). New Ashford, Mass.
106. Granular limestone (with talc). New Ashford, Mass.
107. Limestone with talc. New Ashford, Mass.
108. Ferruginous quartz. Williamstown, Mass.
109. Granular and slaty limestone (with talc). Williamstown.
110. Iron froth. Cortland, Westchester.
111–114. Taconic slate. Hoosick, Rensselaer.
115. Taconic slate. Clinton, Dutchess.
116. Magnesian slate. Taconic range.
117. Magnesian slate. Richmond, Vermont.
118. Magnesian slate. Williamstown, Massachusetts.
119. Magnesian slate (with quartz). Williamstown, Mass.
120. Graphic slate. Bennington, Vermont.
121. Magnesian slate. Saddle mountain, Williamstown.
122. Magnesian slate. Williamstown.

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Vol. V.	NUMBER OF PLATE.	Number of Figs.	Draughtsman.	Lithographer.
Part I.	I.	16	J. H. Emerton	Phil. Ast.
Part I.	II.	19	J. H. Emerton	Phil. Ast.
Part I.	III.	22	J. H. Emerton	Riemann.
Part I.	IV.	11	J. H. Emerton	Riemann.
Part I.	V.	24	J. H. Emerton	Riemann.
Part I.	VI.	9	J. H. Emerton	Riemann.
Part I.	VII.	33	J. H. Emerton	Phil. Ast.
Part I.	VIII.	10	J. H. Emerton	Phil. Ast.
Part I.	IX.	30	J. H. Emerton	Riemann.
Part I.	X.	12	J. H. Emerton	Riemann.
Part I.	XI.	10	G. B. Simpson	Riemann.
Part I.	XII.	9	G. B. Simpson	Phil. Ast.
Part I.	XIII.	15	J. H. E. & G. B. S.	Riemann.
Part I.	XIV.	21	G. B. Simpson	Riemann.
Part I.	XV.	12	J. H. E. & G. B. S.	Riemann.
Part I.	XVI.	14	J. H. Emerton	Phil. Ast.
Part I.	XVII.	31	J. H. Emerton	Phil. Ast.
Part I.	XVIII.	15	J. H. Emerton	Riemann.
Part I.	XIX.	31	J. H. Emerton	Phil. Ast.
Part I.	XX.	19	J. H. Emerton	Riemann.
Part I.	XXI.	40	G. B. Simpson	Phil. Ast.
Part I.	XXII.	28	G. B. Simpson	Riemann.
Part I.	XXIII.	30	G. B. Simpson	Phil. Ast.
Part I.	XXIV.	15	J. H. Emerton	Phil. Ast.
Part I.	XXV.	19	H. H. Martin	Phil. Ast.
Part I.	XXVI.	10	G. B. Simpson	Swinton.
Part I.	XXVII.	9	G. B. Simpson	Swinton.
Part I.	XXVIII.	5	G. B. Simpson	Swinton.
Part I.	XXIX.	6	G. B. Simpson	Swinton.
Part I.	XXX.	7	J. H. Emerton	Swinton.
Part I.	XXXI.	17	J. W. Hall	Swinton.
Part I.	XXXII.	22	J. H. E. & G. B. S.	Riemann.
Part I.	XXXIII.	24	J. W. H. & H. M. M.	Riemann.
Part I.	XXXIV.	17	G. B. Simpson	Swinton.
Part I.	XXXV.	14	E. Emmons	Phil. Ast.
Part I.	XXXVI.	21	G. B. Simpson	Riemann.
Part I.	XXXVII.	17	G. B. Simpson	Swinton.
Part I.	XXXVIII.	16	G. B. Simpson	Riemann.
Part I.	XXXIX.	21	G. B. Simpson	Riemann.
Part I.	XL.	18	G. B. Simpson	Riemann.
Part I.	XLI.	30	G. B. Simpson	Riemann.
Part I.	XLII.	22	E. Emmons	Phil. Ast.
Part I.	XLIII.	21	G. B. Simpson	Phil. Ast.
Part I.	XLIV.	22	G. B. Simpson	Phil. Ast.
Part I.	XLV.	31	G. B. Simpson	Riemann.
Part I.	XLVI.	37	G. B. Simpson	Riemann.
Part I.	XLVII.	55	G. B. Simpson	Phil. Ast.
Part I.	XLVIII.	39	G. B. Simpson	Phil. Ast.
Part I.	XLIX.	38	G. B. Simpson	Phil. Ast.
Part I.	L.	46	G. B. Simpson	Phil. Ast.
Part I.	LI.	33	J. W. Hall	Riemann.
Part I.	LII.	10	G. B. Simpson	Phil. Ast.
Part I.	LIII.	26	G. B. Simpson	Riemann.
Part I.	LIV.	16	G. B. Simpson	Riemann.
Part I.	LV.	11	J. H. Emerton	Swinton.
Part I.	LVI.	8	J. H. Emerton	Swinton.
Part I.	LVII.	10	J. H. Emerton	Riemann.
Part I.	LVIII.	13	J. H. Emerton	Riemann.
Part I.	LIX.	27	J. H. Emerton	Phil. Ast.
Part I.	LX.	11	J. H. Emerton	Riemann.
Part I.	LXI.	33	J. H. Emerton	Phil. Ast.
Part I.	LXII.	19	J. H. Emerton	Riemann.
Part I.	LXIII.	21	J. H. Emerton	Riemann.
Part I.	LXIV.	32	J. W. Hall	Riemann.
Part I.	LXV.	29	G. B. Simpson	Riemann.
Part I.	LXVI.	43	G. B. Simpson	Riemann.
Part I.	LXVII.	32	G. B. Simpson	Phil. Ast.
Part I.	LXVIII.	33	G. B. Simpson	Phil. Ast.
Part I.	LXIX.	14	J. H. Emerton	Riemann.
Part I.	LXX.	25	J. H. Emerton	Riemann.
Part I.	LXXI.	32	J. H. Emerton	Phil. Ast.
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Part I.	LXXIV.	21	G. B. Simpson	Riemann.
Part I.	LXXV.	45	J. W. Hall	Phil. Ast.
Part I.	LXXVI.	31	J. W. Hall	Riemann.
Part I.	LXXVII.	16	J. H. Emerton	Phil. Ast.
Part I.	LXXVIII.	42	J. H. Emerton	Phil. Ast.
Part I.	LXXIX.	49	Geo. B. Simpson	Phil. Ast.
Part I.	LXXX.	12	Geo. B. Simpson	Riemann.
Part I.	LXXXI.	17	E. Emmons	Chas. Van Benthuysen & Sons.
Part I.	LXXXII.	21	E. Emmons	Chas. Van Benthuysen & Sons.
Part I.	LXXXIII.	14	G. B. Simpson	Chas. Van Benthuysen & Sons.
Part I.	LXXXIV.	24	E. Emmons	Chas. Van Benthuysen & Sons.
Part I.	LXXXV.	39	E. Emmons	Phil. Ast.
Part I.	LXXXVI.	9	C. E. Beecher	Chas. Van Benthuysen & Sons.
Part I.	LXXXVII.	13	G. B. Simpson	Chas. Van Benthuysen & Sons.
Part I.	LXXXVIII.	29	E. Emmons	Chas. Van Benthuysen & Sons.
Part I.	LXXXIX.	25	E. Emmons	Chas. Van Benthuysen & Sons.
Part I.	XC.	34	C. E. Beecher	Phil. Ast.
Part I.	XCI.	25	E. Emmons	Chas. Van Benthuysen & Sons.
Part I.	XCII.	10	E. Emmons	Chas. Van Benthuysen & Sons.
Part I.	XCIII.	29	E. Emmons	Phil. Ast.
Part I.	XCIV.	25	E. Emmons	Phil. Ast.
Part I.	XCV.	31	E. Emmons	Phil. Ast.
Part I.	XCVI.	21	E. Emmons	Phil. Ast.
Part II.	I.	23	G. B. Simpson	Riemann.
Part II.	II.	31	G. B. Simpson	Riemann,
Part II.	III.	30	H. M. Martin	Riemann.
Part II.	IV.	20	G. B. Simpson	Riemann.
Part II.	V.	16	G. B. Simpson	Riemann.
Part II.	VI.	3	G. B. Simpson	Riemann.
Part II.	VII.	10	G. B. Simpson	Riemann.
Part II.	VIII.	10	G. B. Simpson	Riemann.
Part II.	IX.	35	H. M. Martin	Phil. Ast.
Part II.	X.	29	H. M. Martin	Phil. Ast.
Part II.	XI.	31	H. M. M. and R. P. W.	Phil. Ast.
Part II.	XII.	40	G. B. Simpson	Phil. Ast.
Part II.	XIII.	25	G. B. Simpson	Riemann.
Part II.	XIV.	17	G. B. Simpson	Riemann.
Part II.	XV.	10	G. B. S. & F. J. S.	P. Riemann.
Part II.	XVI.	28	H. M. Martin	P. Riemann.
Part II.	XVII.	13	G. B. Simpson	Riemann.
Part II.	XVIII.	12	G. B. Simpson	Riemann.
Part II.	XIX.	25	G. B. Simpson	Phil. Ast.
Part II.	XX.	27	G. B. Simpson	Phil. Ast.
Part II.	XXI.	22	G. B. Simpson	Phil. Ast.
Part II.	XXII.	30	G. B. Simpson	Phil. Ast.
Part II.	XXIII.	20	G. B. Simpson	Phil. Ast.
Part II.	XXIV.	19	G. B. Simpson	P. Riemann.
Part II.	XXV.	28	G. B. Simpson	Phil. Ast.
Part II.	XXVI.	28	E. Emmons	Phil. Ast.
Part II.	XXVII.	8	G. B. Simpson	Phil. Ast.
Part II.	XXVIII.	20	G. B. Simpson	Phil. Ast.
Part II.	XXIX.	8	G. B. Simpson	Phil. Ast.
Part II.	XXX.	29	G. B. Simpson	Phil. Ast.
Part II.	XXXI.	25	G. B. Simpson	Phil. Ast.
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Part II.	XXXII.	34	G. B. Simpson	Phil. Ast.
Part II.	XXXIIA.	29	G. B. Simpson	H. Bergman.
Part II.	XXXIII.	9	G. B. Simpson	Phil. Ast.
Part II.	XXXIV.	6	G. B. Simpson	Phil. Ast.
Part II.	XXXIVA.	12	G. B. Simpson	Phil. Ast.
Part II.	XXXV.	16	G. B. Simpson	H. Bergman.
Part II.	XXXVA.	9	G. B. Simpson	P. Riemann.
Part II.	XXXVI.	5	G. B. Simpson	P. Riemann.
Part II.	XXXVII.	9	G. B. Simpson	P. Riemann.
Part II.	XXXVIII.	10	H. M. Martin	P. Riemann.
Part II.	XXXIX.	4	H. M. Martin	P. Riemann.
Part II.	XL.	4	G. B. Simpson	P. Riemann.
Part II.	XLI.	9	G. B. Simpson	P. Riemann.
Part II.	XLII.	12	G. B. Simpson	P. Riemann.
Part II.	XLIII.	15	G. B. Simpson	P. Riemann.
Part II.	XLIV.	2	H. M. Martin	P. Riemann.
Part II.	XLV.	6	H. M. Martin	P. Riemann.
Part II.	XLVI.	15	H. M. M. & R. P. W.	P. Riemann.
Part II.	XLVII.	8	G. B. Simpson	P. Riemann.

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Part II.	XLIX.	2	G. B. Simpson	P. Riemann.
Part II.	L.	2	G. B. Simpson	P. Riemann.
Part II.	LI.	6	G. B. Simpson	P. Riemann.
Part II.	LII.	6	G. B. Simpson	Phil. Ast.
Part II.	LIIA.	8	G. B. Simpson	Phil. Ast.
Part II.	LIII.	6	G. B. Simpson	P. Riemann.
Part II.	LIV.	5	G. B. Simpson	P. Riemann.
Part II.	LV	6	G. B. Simpson	P. Riemann.
Part II.	LVI.	6	G. B. Simpson	P. Riemann.
Part II.	LVII.	7	H. M. Martin	P. Riemann.
Part II.	LVIII.	7	H. M. M. & R. P. W	P. Riemann.
Part II.	LIX.	11	H. M. Martin	P. Riemann.
Part II.	LX.	9	G. B. Simpson	P. Riemann.
Part II.	LXI.	1	G. B. Simpson	Phil. Ast.
Part II.	LXII.	1	G. B. Simpson	Riemann.
Part II.	LXIII.	1	F. J. Swinton	F. J. Swinton.
Part II.	LXIV.	1	G. B. Simpson	Phil. Ast.
Part II.	LXV.	2	G. B. Simpson	Phil. Ast.
Part II.	LXVI.	2	G. B. Simpson	Riemann.
Part II.	LXVII.	1	G. B. Simpson	Riemann.
Part II.	LXVIII.	1	G. B. Simpson	P. Riemann.
Part II.	LXIX.	10	H. M. Martin	P. Riemann.
Part II.	LXX.	15	H. M. Martin	P. Riemann.
Part II.	LXXI.	16	H. M. Martin	P. Riemann.
Part II.	LXXII.	12	H. M. Martin	P. Riemann.
Part II.	LXXIII.	14	H. M. Martin	P. Riemann.
Part II.	LXXIV.	15	H. M. Martin	P. Riemann.
Part II.	LXXV.	4	G. B. Simpson	P. Riemann.
Part II.	LXXVI.	7	G. B. Simpson	P. Riemann.
Part II.	LXXVII.	8	G. B. Simpson	P. Riemann.
Part II.	LXXVIII.	7	G. B. Simpson	P. Riemann.
Part II.	LXXVIIIA.	8	G. B. Simpson	P. Riemann.
Part II.	LXXVIIIB.	5	E. Emmons	H. Bergman.
Part II.	LXXIX.	16	G. B. Simpson	P. Riemann,
Part II.	LXXX.	11	G. B. Simpson	P. Riemann.
Part II.	LXXXI.	13	G. B. Simpson	P. Riemann.
Part II.	LXXXII.	18	G. B. Simpson	Phil. Ast,
Fart II.	LXXXIII.	14	G. B. Simpson	Phil. Ast.
Part II.	LXXXIV.	21	G. B. Simpson	Phil. Ast.
Part II.	LXXXV.	19	G. B. Simpson	Phil. Ast.
Part II.	LXXXVI.	5	G. B. Simpson	P. Riemann.
Part II.	LXXXVII.	6	G. B. Simpson	P. Riemann.
Part II.	LXXXVIII.	2	G. B. Simpson	P. Riemann.
Part II.	LXXXIX.	11	G. B. Simpson	P. Riemann.
Part II.	XC.	17	G. B. Simpson	Phil. Ast.
Part II.	XCI.	5	G. B. Simpson	P. Riemann.
Part II.	XCII.	5	G. B. Simpson	P. Riemann.
Part II.	XCIII.	9	G. B. Simpson	P. Riemann.
Part II.	XCIV.	9	G. B. Simpson	P. Riemann.
Part II.	XCV.	13	G. B. Simpson	Phil. Ast.
Part II.	XCVI.	11	G. B. Simpson	Phil. Ast.
Part II.	XCVII.	11	G. B. Simpson	Phil. Ast.
Part II.	XCVIII.	7	G. B. Simpson	H. Bergman.
Part II.	XCIX.	8	G. B. Simpson	P. Riemann.
Part II.	C.	1	G. B. Simpson	P. Riemann.
Part II.	CI.	1	G. B. Simpson	P. Riemann.
Part II.	CII.	1	G. B. Simpson	P. Riemann.
Part II.	CIII.	4	G. B. Simpson	P. Riemann.
Part II.	CIV.	2	E. Emmons	Phil. Ast.
Part II.	CV.	2	G. B. Simpson	P. Riemann.
Part II.	CVI.	8	G. B. Simpson	P. Riemann.
Part II.	CVII.	8	G. B. Simpson	Phil. Ast.
Part II.	CVIII.	2	G. B. Simpson	Phil. Ast.
Part II.	CIX.	12	G. B. Simpson	H. Bergman.
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Part II.	CXII.	17	E. Emmons	Phil. Ast.
Part II.	CXIII.	25	E. Emmons	Phil. Ast.

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Vol. VII.	CXV.	43	G. B. Simpson	Phil. Ast.
Vol. VII.	CXVI.	31	G. B. Simpson	Phil. Ast.
Vol. VII.	CXVIA.	20	E. Emmons	Phil. Ast.
Vol. VII.	CXVII.	7	E. Emmons	E. Emmons.
Vol. VII.	CXVIII.	15	E. Emmons	E. Emmons.
Vol. VII.	CXIX.	1	E. Emmons	E. Emmons.
Vol. VII.	CXX.	7	E. Emmons	E. Emmons.
Vol. VII.	CXXI.	3	E. Emmons	E. Emmons.
Vol. VII.	CXXIA.	4	E. Emmons	E. Emmons.
Vol. VII.	CXXII.	8	E. Emmons	E. Emmons.
Vol. VII.	CXXIII.	2	E. Emmons	E. Emmons.
Vol. VII.	CXXIV.	7	E. Emmons	E. Emmons.
Vol. VII.	CXXV.	1	E. Emmons	E. Emmons.
Vol. VII.	CXXVI.	7	E. Emmons	E. Emmons.
Vol. VII.	CXXVII.	12	E. Emmons	Phil. Ast.
Vol. VII.	CXXVIII.	7	E. Emmons	Phil. Ast.
Vol. VII.	CXXIX.	3	E. Emmons	E. Emmons.
Vol. VI.	I.	21	G. B. Simpson	Phil. Ast.
Vol. VI.	II.	33	G. B. Simpson	Phil. Ast.
Vol. VI.	III.	15	E. Emmons	Phil. Ast.
Vol. VI.	IV.	2	G. B. Simpson	H. Bergman.
Vol. VI.	V.	3	G. B. Simpson	H. Bergman.
Vol. VI.	VI.	8	G, B. Simpson	Phil. Ast.
Vol. VI.	VII.	15	G. B. Simpson	Phil. Ast.
Vol. VI.	VIII.	8	E. Emmons	Phil. Ast.
Vol. VI.	IX.	17	G. B. Simpson	Phil. Ast.
Vol. VI.	X.	21	G. B. Simpson	Phil. Ast.
Vol. VI.	XI.	41	G. B. Simpson	Phil. Ast.
Vol. VI.	XII.	44	G. B. Simpson	Phil. Ast.
Vol. VI.	XIII.	22	G. B. Simpson	Phil. Ast.
Vol. VI.	XIV.	18	G. B. Simpson	H. Bergman.
Vol. VI.	XV.	13	G. B. Simpson	H. Bergman.
Vol. VI.	XVI.	25	G. B. Simpson	H. Bergman.
Vol. VI.	XVII.	18	G. B. Simpson	H. Bergman.
Vol. VI.	XVIII.	22	G. B. Simpson	Phil. Ast.
Vol. VI.	XIX.	19	G. B. Simpson	Phil. Ast.
Vol. VI.	XX.	22	G. B. Simpson	Phil. Ast.
Vol. VI.	XXI.	22	G. B. Simpson	Phil. Ast.
Vol. VI.	XXII.	48	G. B. Simpson	Phil. Ast.
Vol. VI.	XXIII.	21	G. B. Simpson	Phil. Ast.
Vol. VI.	XXIIIA.	22	G. B. Simpson	Phil. Ast.
Vol. VI.	XXIV.	14	E. Emmons	Phil. Ast.
Vol. VI.	XXV.	36	G. B. Simpson	Phil. Ast.
Vol. VI.	XXVI.	27	G. B. Simpson	Phil. Ast.
Vol. VI.	XXVII.	35	G. B. Simpson	Phil. Ast.
Vol. VI.	XXVIII.	26	G. B. Simpson	Phil. Ast.
Vol. VI.	XXIX.	37	G. B. Simpson	Phil. Ast.
Vol. VI.	XXX.	31	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXI.	41	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXII.	28	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXIII.	25	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXIV.	13	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXV.	18	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXVI.	24	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXVII.	16	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXVIII.	20	G. B. Simpson	Phil. Ast.
Vol. VI.	XXXIX.	20	G. B. Simpson	Phil. Ast.
Vol. VI.	XL.	23	G. B. Simpson	Phil. Ast.
Vol. VI.	XLI.	22	G. B. Simpson	Phil. Ast.
Vol. VI.	XLII.	21	G. B. Simpson	Phil. Ast.
Vol. VI.	XLIII.	13	G. B. Simpson	Riemann.
Vol. VI.	XLIV.	18	G. B. Simpson	Phil. Ast.
Vol. VI.	XLV.	23	G. B. Simpson	Phil. Ast.
Vol. VI.	XLVI.	36	G. B. Simpson	Phil. Ast.
Vol. VI.	XLVII.	36	G. B. Simpson	Phil. Ast.
Vol. VI.	XLVIII.	17	G. B. Simpson	P. Riemann.
Vol. VI.	XLIX.	22	G. B. Simpson	P. Riemann.
Vol. VI.	L.	19	G. B. Simpson	P. Riemann.
Vol. VI.	LI.	23	G. B. Simpson	Phil. Ast.
Vol. VI.	LII.	23	G. B. Simpson	P. Riemann.
Vol. VI.	LIII.	17	G. B. Simpson	Phil. Ast.
Vol. VI.	LIV.	25	G. B. Simpson	P. Riemann.

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Vol. VI.	LVII.	20	G. B. Simpson..............	Phil. Ast.
Vol. VI.	LVIII.	23	G. B. Simpson..............	Phil. Ast.
Vol. VI.	LIX.	14	G. B. Simpson..............	Phil. Ast.
Vol. VI.	LX.	22	G. B. Simpson..............	Phil. Ast.
Vol. VI.	LXI.	27	G. B. Simpson..............	Phil. Ast.
Vol. VI.	LXII.	29	G. B. Simpson..............	Phil. Ast.
Vol. VI.	LXIII.	24	G. B. Simpson..............	Phil. Ast.
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Vol. VI.	LXV.	21	G. B. Simpson..............	Phil. Ast.
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Vol. VII.	II.	12	G. B. Simpson..............	Phil. Ast.
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RECORD OF LOCALITY NUMBERS.

Record of numbers on orange-colored tickets, marking the specimens collected for the illustration of the Palæontology of the State of New York; beginning under the first appropriation made by the State for the collection of fossils for that object in 1856.

The name of the collector, date and locality are usually given, but in a few instances the date was not recorded at the time of the entry.

These locality numbers have been attached to all the specimens which have been sent from the State Museum, to the schools, academies and colleges of the State, and in exchanges with other institutions.

No. 1. Hamilton group. One mile south of Leonardsville, Madison county, in bluff on the west side of the plank-road. Three hundred and seventy to 400 feet above the Marcellus Shale. F. B. Meek, R. P. Whitfield and C. Van Deloo, collectors. 1857.

No. 2. Marcellus Shale. One and a half miles south of Bridgewater at the side of plank-road and in bed of brook. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 3. Hamilton group. Top of the bluff east of Unadilla Forks, Otsego county. About 320 feet above Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 4. Hamilton group. In the bluff east of Unadilla Forks, Otsego county. Two hundred and fifty to 330 feet above Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 5. Hamilton group. Bluff one mile south of Plainfield Centre, Otsego county. From 300 to 320 feet above the Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 6. Hamilton group. Quarry up the ravine, west of Leonardsville, Madison county. About 320 feet above the Marcellus Shale near the top of No. 3 of section at Unadilla. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 6½. Hamilton group. Locality same as No. 6. Position, Blue Shales, No. 5 of section at Unadilla (resting on No. 3). Meek, Whitfield and Van Deloo collectors. 1857.

No. 7. Hamilton group. Found loose in the neighborhood of Unadilla Forks, Otsego county. On the Madison county side of the river. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 8. Hamilton group. Three miles south of Unadilla Forks, Otsego county. Position, Lower-Hamilton. (Found loose and in detached masses.) Meek, Whitfield and Van Deloo, collectors. 1857.

No. 9. Hamilton group. Presented in part by John B. Wells and others; collected in the neighborhood of Unadilla Forks, Otsego county, N. Y. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 10. Hamilton group. From a ledge one-half mile south of Leonardsville, Madison county. From 370 to 430 feet above the Marcellus Shale, No. 6 of section at Unadilla. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 11. Hamilton group. From bank of brook one mile south of Unadilla Forks on east side of river. Blue Shale, No. 2 of section at Unadilla (resting on Marcellus Shale?). Meek, Whitfield and Van Deloo, collectors. 1857.

No. 12. Hamilton group. One mile south of Leonardsville, Madison county. In quarry on west side of the plank-road, No. 4 of section at Unadilla Forks, about 320 feet above the Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 13. Hamilton group. Opposite Leonardsville, Madison county, on east side of the Unadilla river. Position, lower part of No. 3 of section at Unadilla Forks. About 250 feet above the Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 14. Hamilton group. From the top of the falls three miles southwest of Leonardsville, Madison county. About 430 feet above the Marcellus Shale, No. 7 of section at Unadilla Forks. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 15. Hamilton group. In the bed of the stream, about 100 yards below the falls, three miles southwest of Leonardsville, Madison county. No. 5 of section, about 370 feet above the Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 16. Hamilton group. From a ledge one and one-half miles southwest of Leonardsville. Position about 540 feet above the Marcellus Shale, No. 10 of section at Unadilla Forks. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 17. Hamilton group. From two to two and one-half miles southwest of Leonardsville, Madison county. Position No. 8 of section at Unadilla Forks. About 434 feet above the Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 17½. Position same as 17. Locality, upper part of ravine top of cliff (below the falls), three miles southwest of Leonardsville, Madison county. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 18. Hamilton group. Found loose about two and one-half miles southwest of Leonardsville, Madison county. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 19. Hamilton group. One and one-half miles southwest of Leonardsville, Madison county. Position, No. 6 of section. About 420 feet above the Marcellus Shale. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 20. Hamilton group. Presented by Dr. Crandall of Leonardsville, Madison county. Other specimens with the same number were collected in the neighborhood by Meek, Whitfield and Van Deloo. 1857.

No. 21. Fragments collected on the road between Bridgewater and Unadilla Forks. Some Hamilton and some Corniferous fossils. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 22. Pentamerus limestone. Schoharie, N. Y. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 23. Delthyris shaly limestone. Schoharie, N. Y. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 24. Tentaculite limestone. Schoharie, N. Y. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 25. Oriskany Sandstone. Loose mass. Schoharie, N. Y. Meek, Whitfield and Van Deloo, collectors. 1857.

No. 26. Hamilton group. Near the top of a cliff, east of Middleburgh, Schoharie county. Estimated height, about 300 feet above the level of Schoharie creek. Wm. M. Gabb, collector. 1857.

No. 27. Schoharie grit. From a stone wall one half mile east of Middleburgh, Schoharie county. Wm. M. Gabb, collector. 1857.

No. 28. From a boulder in Schoharie creek, three-fourths mile east of Fultonham, Schoharie county, N. Y. Wm. M. Gabb, collector. 1857.

No. 29. Hamilton group. One and one-half miles southwest of Fultonham, Schoharie county, about 250 feet above the level of Schoharie creek. Wm. M. Gabb, collector. 1857.

No. 30. Hamilton group. One and one-half miles southwest of Fultonham, Schoharie county, about 270 feet above the level of the Schoharie creek. Wm. M. Gabb, collector. 1857.

No. 31. Hamilton group. One mile east of Fultonham, Schoharie county. From loose masses which had fallen from the ledge above. Wm. M. Gabb, collector. 1857.

No. 32. Hamilton group. Four miles northeast of Middleburgh, Schoharie county. Loose masses on the hill. Wm. M. Gabb, collector. 1857.

No. 33. Hamilton group. Base of hill two miles south of Fultonham, Schoharie county, N. Y. In bank of small stream. Wm. M. Gabb, collector. 1857.

No. 34. Hamilton group. One mile south of Fultonham, Schoharie county, about twenty-five feet above level of Schoharie creek, east side. Wm. M. Gabb, collector. 1857.

No. 35. Hamilton group. Boulders from a small stream one mile south of Fultonham, Schoharie county. Wm. M. Gabb, collector. 1857.

No. 36. From boulders in Schoharie creek. One mile south of Fultonham, Schoharie county. Wm. M. Gabb, collector. 1857.

No. 37. Hamilton group. Found loose in a branch of Schoharie creek, two and one-half miles south of Fultonham, Schoharie county. Wm. M. Gabb, collector. 1857.

No. 38. Hamilton group. From above the falls, one and one-half miles west of Fultonham, Schoharie county. Wm. M. Gabb, collector. 1857.

No. 39. Hamilton group. From below the falls, one and one-half miles west of Fultonham, Schoharie county. Wm. M. Gabb, collector. 1857.

No. 40. Hamilton group. One-half mile west of Fultonham, Schoharie county, about sixty feet above the level of Schoharie creek. Wm. M. Gabb, collector. 1857.

No. 41. Hamilton group. One mile south of Fultonham, Schoharie county, about ten feet above the water level on west side of creek. Wm. M. Gabb, collector. 1857.

No. 42. Hamilton group. Boulder, one-half mile south of Fultonham, Schoharie county, N. Y., in Schoharie creek. Wm. M. Gabb, collector. 1857.

No. 43. Hamilton group. Two and one-half miles south of Fultonham, Schoharie, county, 100 feet west of the falls. Wm. M. Gabb, collector. 1857.

No. 44. Hamilton group. On Skaneateles lake, near Spafford Corners, at the level of the lake. Wm. M. Gabb, collector. 1857.

No. 45. Hamilton group. Skaneateles lake, one mile north of Spafford Corners. Elevation, from forty to fifty feet above the level of the lake. Wm. M. Gabb, collector. 1857.

No. 46. Marcellus Shale. Three miles southeast of Skaneateles village, at water level. Wm. M. Gabb, collector. 1857.

No. 47. Hamilton group. Ravine at Spafford Corners, 300 feet above the level of Skaneateles lake. Wm. M. Gabb, collector. 1857.

No. 48. Hamilton group. Skaneateles lake, one mile north of Spafford Corners. Elevation varying from ten to forty feet. Wm. M. Gabb, collector. 1857.

No. 49. Hamilton group. Loose mass, one mile south of Borodino, near Skaneateles lake. Wm. M. Gabb, collector. 1857.

No. 50. Oriskany Sandstone. Quarry one-half mile southeast of Skaneateles Junction. Wm. M. Gabb, collector. 1857.

No. 51. Limestone underlying Oriskany Sandstone at quarry. One-half mile southeast of Skaneateles Junction. Wm. M. Gabb, collector. 1857.

No. 52. Limestone. About fifteen feet above the level of creek. One-half mile north of Marcellus village. Wm. M. Gabb, collector. 1857.

No. 53. Limestone. Found loose one-half mile south of Skaneateles Junction. Wm. M. Gabb, collector. 1857.

No. 54. Limestone. Quarry one mile south of Skaneateles Junction. Wm. M. Gabb, collector. 1857.

No. 55. Hamilton group. Found loose four miles south of Skaneateles village. Wm. M. Gabb, collector. 1857.

No. 56. Hamilton Group. Ravine one mile north of Spafford Corners, Skaneateles lake. Wm. M. Gabb, collector. 1857.

No. 57. Hamilton group. Loose rocks from various localities. Wm. M. Gabb, collector. 1857.

No. 58. Gypsum. One and one-half miles north of Marcellus village, Onondaga county. Wm. M. Gabb, collector. 1857.

No. 59. Presented by W. Emmons, of Borodino, Onondaga county. Others having the same number collected by Wm. M. Gabb. 1857.

No. 60. Hamilton group. From the base of the hill composed of this group at the north side of Cumberland City, Maryland. R. P. Whitfield and C. Van Deloo, collectors. 1858.

No. 61. Hamilton group. Mostly loose fragments which have been plowed up from the underlying rocks at the summit of the hill north of Cumberland City, Maryland. R. P. Whitfield and C. Van Deloo, collectors. 1858.

No. 62. Hamilton group. From the shales of this group exposed a few rods north of the dwelling-house on Mr. Howe's farm, three miles south of Paterson's Creek station, which is eight miles east of Cumberland City. This locality is in Virginia three miles from the Potomac river. Whitfield and Van Deloo, collectors. 1858.

No. 63. (Probably Chemung.) These fossils are from the rocks about half way between New Creek and Piedmont stations, close to the railroad or twenty-six miles west of Cumberland City, Mary-

land, and are known as Old Red Sandstone. Whitfield and Van Deloo, collectors. 1858.

No. 64. Hamilton group. Canandaigua lake-shore, from one to one and a half miles below Monteith's Point landing, N. Y. Whitfield and Van Deloo, collectors. 1858.

No. 65. Hamilton group. Specimens from the rocks about half a mile below the landing at Monteith's Point, Canandaigua lake-shore. Whitfield and J. W. Hall, collectors, 1858.

No. 66. Hamilton group. Specimens from the rocks between half a mile and a mile below the landing at Monteith's Point, Canandaigua lake-shore. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 67. Hamilton group. Specimens collected in the ravine, near Monteith's House, at and above the dam. Monteith's Point, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 68. Hamilton group. Specimens collected in the ravine near Monteith's house, Monteith's Point, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 69. Hamilton group. Specimens collected from the rocks forming the falls in the ravine above Monteith's house, about one and a half miles back from the lake shore, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 70. Hamilton group. Specimens collected from the Chonetes bed, at or near the level of the lake, in front of Mr. Gelder's house, one mile above Monteiths'. Canandaigua lake-shore. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 71. Hamilton group. Specimens collected a little below Black Point, three miles above Monteith's Point, Canandaigua Lake. A few of the specimens marked with this number, are from the *east side* of the *lake*, opposite Black Point in a similar position. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 72. Hamilton group. Specimens collected in the small ravine which passes from Mr. Gelder's house to the lake-shore, from ten to fifteen feet above the water level. Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 73. Hamilton group. Specimens collected half a mile below Black Point, Canandaigua lake. R. P. Whitfield and J. W. Hall, collectors. 1858.

No. 74. Hamilton group. *Crinoids* from North Bristol, Ontario county, N. Y., on land of Mr. Sisson, found in the bed of the stream. C. A. White and C. Van Deloo, collectors. 1860.

No. 75. Hamilton group. *Crinoids* from Fall Brook, one and one-half miles north of Geneseo, Livingston county, N. Y., in the bed of

the stream, on the north side of the ravine, and on the same level with the track of the Genesee Valley railroad. C. A. White and C. Van Deloo, collectors. 1860.

No. 76. Hamilton group. *Crinoids* from the west shore of Canandaigua lake. All the specimens (with two or three exceptions) were collected along the lake shore where the shale is exposed, from below the water level to six or eight feet above it, and *north* of Monteith's Point. The exceptions are from a similar position above the lake, south of Monteith's Point. C. A. White and C. Van Deloo, collectors. 1860.

No. 77. Hamilton group. *Crinoids* from calcareous shales near the railroad station, Geneseo, Livingston county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 78. Hamilton group. *Crinoids* from York, Livingston county, N. Y., and its vicinity. C. A. White and C. Van Deloo, collectors. 1860.

No. 79. Hamilton group. Specimens collected from ravines coming into Mud creek in the vicinity of Muttonville, North Bristol township, Ontario county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 80. Hamilton group. Specimens collected at, and in the vicinity of Geneseo, Livingston county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 81. Hamilton group. Specimens collected near Moscow, Livingston county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 82. Hamilton group. Specimens collected at, and in the vicinity of York, Livingston county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 83. Hamilton group. Specimens collected from a bank of shale on the east side of the creek above the mill, about two miles south of Pavilion village, Genesee county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 84. Hamilton group. Specimens collected from a shallow ravine on the east side of the road between Pavilion village and Pavilion Center, about one mile north of Pavilion village, Genesee county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 85. Hamilton group. Specimens collected at, and in the vicinity of Bethany, Genesee county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 86. Hamilton group. Specimens collected at Eighteen-mile creek, Erie county, N. Y. C. A. White, collector, 1860, and C. Van Deloo, collector. 1864.

No. 87. Hamilton group. Specimens collected at, and in the vicinity of "Hamburg on the Lake," Erie county, N. Y. C. A. White, collector, 1860, and C. Van Deloo, collector. 1864.

No. 88. Marcellus Shale. (Some specimens of Corniferous Limestone.) Specimens collected at Littleville, near West Avon, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 89. Marcellus Shale. Specimens collected in a ravine about two miles west of Alden, Erie county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 90. Hamilton group. Specimens collected on Hemlock creek, Richmond township, Ontario county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 91. Hamilton group. Specimens collected at, and in the vicinity of Monteith's Point, along the west shore of Canandaigua lake, Ontario county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 92. Hamilton group. Specimens collected in the vicinity of Darien Centre and Darien village, Genesee county, N. Y. C. A. White, 1860, and C. Van Deloo, collectors. 1864.

No. 93. Hamilton group. Specimens collected in a ravine about three-fourths of a mile south of Alexander, Genesee county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 94. Hamilton group. Specimens collected in the vicinity of Dresden, Yates county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 95. Hamilton group. Specimens collected on Coshung creek, near Bellona, Yates county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 96. Hamilton group. Specimens collected on Benton run, three miles north of Bellona, Yates county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 97. Hamilton group. Specimens collected on Cromwell's creek, four miles south of Geneva, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 98. Tully limestone. Specimens collected at Bellona, Yates county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 99. Tully Limestone. Specimens collected near Dresden, Yates county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 100. Hamilton group. *Crinoids.* Specimens collected at Coshung creek, near Bellona, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 101. Hamilton group. *Crinoids.* Specimens collected at Benton run, three miles north of Bellona, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 102. Hamilton group. *Crinoids.* Collected near Dresden, Yates county, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 103. Hamilton group. Specimens found in the road in the extreme southern part of, and at Gates' Mill in West Bloomfield, N. Y. C. A. White and C. Van Deloo, collectors. 1860.

No. 104. Corniferous Limestone. Clarence Hollow, N. Y. R. P. Whitfield, C. A. White and C. Van Deloo, collectors. 1860.

No. 105. Onondaga limestone. From loose pieces of rock on Schultz's farm, three miles west of Clarence Hollow, N. Y. C. A. White, R. P. Whitfield and C. Van Deloo, collectors. 1860.

No. 106. Corniferous Limestone. Specimens from a limestone quarry and lime-kiln, one mile west of Clarence Hollow, N. Y. White, Whitfield and Van Deloo, collectors. 1860.

No. 107. Corniferous Limestone. From quarries on Mr. Young's farm near Williamsville, N. Y. White, Whitfield and Van Deloo, collectors. 1860.

No. 108. Corniferous limestone. Beds near plaster-mill, Williamsville, N. Y. White, Whitfield and Van Deloo, collectors. 1860.

No. 109. Waterlime beds at Williamsville, N. Y. White, Whitfield and Van Deloo, collectors. 1860.

No. 110.* Chemung group. Specimens from Richfield, Summit county, Ohio. Go north from Richfield Center (east village), about half a mile, turn to the left, across the fields a few hundred yards into the bed of a small stream. C. A. White, collector. 1861.

No. 111.* Chemung group. Specimens from Whetstone creek, near the village of Bridgeport, town of Canaan, Wayne county, Ohio. C. A. White, collector. 1861.

No. 112.* Chemung group. Specimens from Mallet's creek, about two miles north of the village of York Center, Medina county, Ohio. C. A. White, collector. 1861.

No. 113.* Chemung group. Specimens from Medina, Medina county, Ohio. Go down the creek about half a mile southeast of village. C. A. White, collector. 1861.

No. 114.* Chemung group. Specimens collected at Lodi, town of Harrisville, Medina county, Ohio. Go up the creek from the village and examine the shales and flagstones for the distance of a mile and a half. C. A. White, collector. 1861.

No. 115.* Chemung group. Specimens collected at Chatham Centre, Medina county, Ohio, along the bed of the creek, about a quarter of a mile southeast of village. C. A. White, collector. 1861.

No. 116.* Chemung group. Specimens from the east bank of the creek, near the waters edge, about a mile northwest of the village of Warren, Trumbull county, Ohio. C. A. White, collector. 1861.

* The numbers 110 to 126 inclusive, recorded as Chemung group, are from the Waverly group of Ohio. The record as left by Mr. White is simply copied in this place.

No. 117.* Chemung group. Specimens collected at Bagdad, one and one-half miles southwestward from Weymouth, Medina county, Ohio. C. A. White, collector. 1861.

No. 118.* Chemung group. Specimens collected near Titusville, from loose masses in the valley of Oil creek, Venango county, Penn. C. A. White, collector. 1861.

No. 119.* Chemung group. Specimens collected at Meadville, Crawford county, Penn., about a mile westward from the center of the village, about half-way up the hill on the north side of the creek. C. A. White, collector. 1861.

No. 120.* Chemung group. Specimens collected at Abbeyville, Medina county, Ohio. C. A. White, collector. 1861.

No. 121.* Chemung group. Specimens collected at Akron, Summit county, Ohio. C. A. White, collector. 1861.

No. 122.* Chemung group. Specimens from Cuyahoga falls, Summit county, Ohio. C. A. White, collector. 1861.

No. 123.* Chemung group. Specimens found loose at Franklin, Venango county, Penn. C. A. White, collector. 1861.

No. 124.* Chemung group. Specimens from the town of Penfield, three miles west of Litchfield, in Lorain county, Ohio. C. A. White, collector. 1861.

No. 125.* Chemung group. Specimens from the "Cauda galli" bed, one and one-half miles south of Liverpool, Medina county, Ohio. C. A. White, collector. 1861.

No. 126.* [Waverly group]. Found in the drift at Medina, Ohio. C. A. White, collector. 1861.

No. 127. Marcellus shale? Castleton, Ontario county, N. Y., five miles west of Geneva, N. Y. C. A. White, collector. 1861.

No. 128. Marcellus Shale. Specimens from Flint creek, a little below Orleans, in the town of Phelps, Ontario county, N. Y. C. A. White, collector. 1861.

No. 129. Goniatite Limestone. Cherry Valley, N. Y. C. A. White, collector. 1860 and 1861.

No. 130. Goniatite Limestone. Marcellus, N. Y. C. A. White, collector. 1860 and 1861.

No. 131. Goniatite Limestone. Two miles west of Manlius Square, Onondaga county, N. Y. C. A. White, collector. 1860 and 1861.

No. 132. Corniferous Limestone. Black Rock, N. Y. C. A. White, collector. 1860 and 1861.

No. 133. Upper Helderberg Limestone. Specimens collected at Warner's quarry, four miles northwest from LeRoy, N. Y. C. A. White, collector. 1860 and 1861.

No. 134. Upper Helderberg Limestone. Specimens collected near (north of) LeRoy, N. Y. C. A. White, collector. 1860 and 1861.

No. 135. Upper Helderberg Limestone. Specimens collected near Caledonia, N. Y. C. A. White, collector. 1860 and 1861.

No. 136. Upper Helderberg Limestone. Specimens collected at Cherry Valley, N. Y. C. A. White, collector. 1860 and 1861.

No. 137. Upper Helderberg Limestone. Specimens from Eastman's quarry, three miles north of Waterville, N. Y. C. A. White, collector. 1860 and 1861.

No. 138. Upper Helderberg Limestone. Specimens from an exposure near the road, in a small creek, two miles northeast from Waterville, N. Y. C. A. White, collector. 1860 and 1861.

No. 139. Upper Helderberg Limestone. Specimens collected from Babcock's Hill, Bridgewater, Oneida county, N. Y. C. A. White, collector. 1860 and 1861.

No. 140. Upper Helderberg Limestone. Specimens from north of Batavia, N. Y. C. A. White, collector. 1860 and 1861.

No. 141. Upper Helderberg Limestone. Specimens collected at Onondaga Valley, N. Y. C. A. White, collector. 1860 and 1861.

No. 142. Upper Helderberg Limestone. Specimens collected at Williamsville, N. Y. C. A. White, collector. 1860 and 1861.

No. 143. Upper Helderberg Limestone. Akron, N. Y. C. A. White, collector. 1860 and 1861.

No. 144. Upper Helderberg Limestone. Clarence Hollow, N. Y. C. A. White, collector. 1860 and 1861.

No. 145. Upper Helderberg Limestone. Two miles west of Manlius Square, N. Y. C. A. White, collector. 1860 and 1861.

No. 146. Upper Helderberg Limestone. Stafford, N. Y. C. A. White, collector. 1860 and 1861.

No. 147. Upper Helderberg Limestone. Shortsville, near Manchester, and seven miles northward from Canandaigua, N. Y. C. A. White. 1860 and 1861.

No. 148. Hamilton group. Specimens from Tassel Hill, three miles east of Waterville, N. Y. C. A. White, collector. 1860 and 1861.

No. 149. Lower Marcellus Shale. Marcellus, N. Y. C. A. White, collector. 1860 and 1861.

No. 150. Upper Helderberg Limestone. Cassville, Oneida county, N. Y. C. A. White, collector. 1860 and 1861.

No. 151. Upper Helderberg Limestone. Specimens from one mile east of Jamesville, Onondaga county, N. Y. C. A. White, collector. 1860 and 1861.

No. 152. Lower Marcellus Shale. Two and a half miles west of Manlius Square, N. Y. C. A. White, collector. 1860 and 1861.

No. 153. Upper Helderberg, etc. Specimens collected from walls, at "Dry Lots," Herkimer county, N. Y. C. A. White, collector. 1860 and 1861.

No. 154. Upper Helderberg Limestone. Specimens from one mile east of Babcock Hill, Bridgewater, N. Y. C. A. White, collector. 1860 and 1861.

No. 155. Lower Helderberg. Specimens from the upper beds at Jerusalem Hill. No. 5 of section No. 1 of Jerusalem Hill. C. A. White, collector. 1860 and 1861.

No. 156. Lower Helderberg of Jerusalem Hill, from No. 3 of section No. 1, C. A. White, collector. 1860 and 1861.

No. 157. Lower Helderberg of Jerusalem Hill, from No. 5 of section No. 2. C. A. White, collector. 1860 and 1861.

No. 158. Lower Helderberg of Jerusalem Hill, from No. 7 of section No. 2. C. A. White, collector. 1860 and 1861.

No. 159. Lower Helderberg of Jerusalem Hill, from No. 9 of section No. 2. C. A. White, collector. 1060 and 1861.

No. 160. Lower Helderberg Limestone. One mile east of Sennett Station, N. Y. C. R. R. C. A. White, collector. 1860 and 1861.

No. 161. Lower Helderberg Limestone. From Rockville near Sharon Springs. C. A. White, collector. 1860 and 1861.

No. 162. Lower Helderberg Limestone. Paris Hill, N. Y. C. A. White collector. 1860 and 1861.

No. 163. Lower Helderberg Limestone. From Leesville, three miles west of Sharon Springs, N. Y. C. A. White, collector. 1860 and 1861.

No. 164. Lower Helderberg Limestone. Cherry Valley, N. Y. From the upper part of No. 3 of Cherry Valley section. C. A. White, collector. 1860 and 1861.

No. 165. Lower Helderberg Limestone. Cherry Valley, N. Y. From the lower part of No. 3 of Cherry Valley section. C. A. White, collector. 1860 and 1861.

No. 166. Waterlime. ? From No. 1 of section. Four miles south of Cayuga village, N. Y. C. A. White, collector. 1860 and 1861.

No. 167. Lower Helderberg Limestone? From No. 2 of section. Four miles south of Cayuga village, N. Y. C. A. White, collector. 1860 and 1861.

No. 168. Oriskany Sandstone? Cherry Valley, N. Y. No. 4 of Cherry Valley section. C. A. White, collector. 1860 and 1861.

No. 168*. Upper Helderberg Limestone. Springport on Cayuga lake, N. Y. C. A. White, collector. 1860 and 1861.

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* Number 168 is repeated by an oversight. The character of the fossils however, is such that they can be readily distinguished.

No. 169. Lower Marcellus Shale. From Cherry Valley, not fossiliferous. Specimens collected in 1864 by C. Van Deloo, with fossils (number doubly underscored). C. A. White, collector. 1860 and 1861.

No. 170. Upper Helderberg Limestone. Specimens from quarries about three miles northeast of Buffalo. C. A. White, collector. 1860 and 1861.

No. 171. Upper Helderberg Limestone. Waterloo, N. Y. C. A. White, collector. 1860 and 1861.

No. 172. Waterlime. Two and one-half miles southeast of Cayuga village, N. Y. C. A. White, collector. 1860 and 1861.

No. 173. Marcellus Shale. From the bed of Flint creek, four and one-half miles southeast from Clifton Springs. C. A. White, collector. 1860 and 1861.

No. 174. Hamilton Shale. Near Ludlowville, N. Y. C. A. White, collector. 1860 and 1861.

No. 175. Hamilton Shale. From the east bank of Cayuga lake, three miles south of Ogden's Ferry. C. A. White, collector. 1860 and 1861.

No. 176. Hamilton Shale. From the east landing of Ogden's or Kidder's Ferry, Cayuga lake. C. A. White, collector. 1860 and 1861.

No. 177. Oriskany Sandstone. Four miles southwest of Auburn, N. Y., on land of Mr. Baker. Including specimens of Favosites which are from the Upper Helderberg Limestone. C. A. White, collector. 1860 and 1861.

No. 178. Upper Helderberg Limestone. From Gidding's quarries three miles north of Canandaigua, N. Y. C. A. White, collector. 1860 and 1861.

No. 179. Upper Helderberg Limestone. From North Lima, two miles westward from Honeoye falls. C. A. White, collector. 1860 and 1861.

No. 180. Hamilton Shale. Three and a half miles south of Castleton, on Flint creek, Ontario county, N. Y. J. Hall, collector. 1860 and 1861.

No. 181. Upper Helderberg Limestone. Fish remains, etc., near Clifton Springs, N. Y. C. A. White, collector. 1861.

No. 182. Schoharie Grit. Specimens collected in the neigborhood of Clarksville, Albany county, N. Y. R. P. Whitfield and C. Van Deloo, collectors. 1861.

No. 183. Schoharie Grit. Near Clarksville, Albany county, N. Y. C. Van Deloo, collector. 1862.

No. 184. Schoharie Grit. Collected in the town of Knox, Albany county, N. Y. C. Van Deloo, collector. 1862.

No. 185. Corniferous Limestone. Collected at the patent lime-kiln near Clarksville, Albany county, N. Y. C. Van Deloo, collector. 1862.

No. 186. Schoharie Grit. Schoharie, N. Y. C. Van Deloo, collector. 1862.

No. 187. Genesee Slate. From Crooked creek, near Darien, N. Y. C. Van Deloo, collector. 1864.

No. 188. Hamilton group. Hill south and west of Schoharie. C. Van Deloo, collector. 1862.

No. 189. Lower Helderberg. Schoharie. C. Van Deloo, collector. 1862.

No. 190. Hamilton group. Specimens collected from a thin band of dark shale, just at the base of the falls, in the ravine at the south line of Mr. Geldus' farm. Canandaigua lake. R. P. Whitfield and C. Van Deloo, collectors. 1862.

No. 191. Hamilton group. Specimens collected along the west shore of Canandaigua lake and in the adjacent ravines. R. P. Whitfield and C. Van Deloo, collectors. 1862.

No. 192. Hamilton group. Collected in the ravines in the neighborhood of Muttonville, N. Y. R. P. Whitfield and C. Van Deloo, collectors. 1862.

No. 193. Portage group. From a ravine terminating at the village of Bristol Centre, Ontario county, N. Y. Specimens collected near the base of the group. Whitfield and Van Deloo, collectors. 1862.

No. 194. Genesee Slate. From the ravine at Bristol Centre, Ontario county. Within a few feet of the top of group. Whitfield and Van Deloo, collectors. 1862.

No. 195. Portage group. Fossil plants from the black bands of shale in the Portage group in ravine at Bristol Centre. The bands possessing the character of Genesee Slate. Whitfield and Van Deloo, collectors. 1862.

No. 196. Hamilton group. From a ravine bearing the name of "Bear Gulf," about two and a half miles north of Summit Corners, Schoharie county, N. Y. C. Van Deloo, collector. 1862.

No. 197. Hamilton group. Collected from loose masses in the vicinity of Apulia, Onondaga county, N. Y. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 198. Hamilton group. Specimens collected at the base of a small waterfall on the creek at the crossing of the road running north from Tully village (two miles). The Tully Limestone forms the top of the falls, the Hamilton Shales the base. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 199. Tully Limestone. From the limestone layers at the top of the formation as seen at Tinker's falls, Onondaga county, N. Y. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 200. Hamilton group. Specimens collected from stream one-quarter mile east of the village of Moravia, George B. Simpson, collector. 1863.

No. 201. Hamilton group. Specimens collected from dry creek, three-quarters of a mile south of village of Moravia. George B. Simpson, collector. 1863.

No. 202. Hamilton group. Specimens collected from masses of rock at base of Pratt's falls, Pompey Hill. George B. Simpson, collector. 1863.

No. 203. Hamilton group. Specimens collected from loose pieces one mile north of village of Pompey Hill. George B. Simpson, collector. 1863.

No. 204. Chemung group. Three miles west of East Randolph, township of Conewango, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 205. Chemung group. Specimens collected near East Randolph, Cattaraugus county, N. Y. C. Van Deloo, collector.

No. 206. Chemung group. Near town line, between Napoli and Conewango, N. Y. C. Van Deloo, collector. 1863.

No. 207. Chemung group. Town line, between Napoli and Cold Spring, near East Randolph. C. Van Deloo, collector. 1863.

No. 208. Chemung group. Elm Creek, town of Conewango, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 209. Chemung group. New Albion, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 210. Chemung group. Napoli Centre, Cold Spring Creek, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 211. Chemung group. Cold Spring Creek, town of Napoli, three-quarters of a mile north of Cold Spring, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 212. Chemung group. Dry creek, Conewango, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 213. Chemung group. Cold Spring, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 214. Chemung group. Randolph, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 215. Chemung group. Collected two miles southwest of Steamburg Station, Cold Spring, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 216. Chemung group. Specimens collected at Wolf run, town of South Valley, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 217. Chemung group. Leon village, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 218. Chemung group. Specimens collected one and a half miles southeast of East Randolph, in the town of Cold Spring, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 219. Chemung group. Specimens collected at Ellington, Chautauqua county, N. Y. C. Van Deloo, collector, 1863.

No. 220. Chemung group. Loose specimens collected along the hill road from Ellington to Cherry Creek, Chautauqua county, N. Y. C. Van Deloo, collector. 1863.

No. 221. Chemung group. Specimens collected on Mr. Gardner's farm, near Cherry Creek, Chautauqua county, N. Y. C. Van Deloo, collector. 1863.

No. 222. Chemung group. Loose specimens collected in the village of Cherry Creek, Chautauqua county, N. Y. C. Van Deloo, collector. 1863.

No. 223. Chemung group. Specimens collected near Horse Corners, township of New Albion, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 224. Chemung group. Specimens collected at Bear's Gulf, one and a half miles west from Horse Corners, New Albion, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 226. Chemung group. Specimens collected at Meadville, Penn. C. Van Deloo, collector. 1863.

No. 227. Hamilton group. Specimens collected from ravine, three-fourths of a mile north-west of Delphi village, N. Y. George B. Simpson, collector. 1863.

No. 228. Hamilton group. Specimens collected from Delphi falls, one mile southeast of village. George B. Simpson, collector. 1863.

No. 229. Hamilton group. Specimens collected from quarry, two miles southeast of Delphi village, N. Y. George B. Simpson, collector. 1863.

No. 230. Hamilton group. Specimens collected from Ten-mile Point gulf, Skaneateles lake, six miles from the head, east side. George B. Simpson, collector. 1863.

No. 231. Hamilton group. Specimens collected from the Lower Basin gulf, Skaneateles lake, five miles from head of lake; east side. George B. Simpson, collector. 1863.

No. 232. Hamilton group. Specimens collected from ravines running into Owasco lake, east side, from the head to four miles down. George B. Simpson, collector. 1863.

No. 233. Hamilton group. Specimens collected from ravines running into Otisco lake, west side. George B. Simpson, collector. 1863.

No. 234. Hamilton group. Specimens collected from ravines running into inlet of Otisco lake, east side. George B. Simpson, collector. 1863.

No. 235. Hamilton group. Specimens collected from Tinker's falls, four miles from Apulia station. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 236. Tully Limestone. Specimens collected from Rhynchonella bed, Tinker's falls. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 237. Hamilton group. Specimens collected from ravines running into west side of Onondaga creek, four miles south of Cardiff. George B. Simpson, collector. 1863.

No. 238. Hamilton group. Specimens collected from ravine running into east side of Onondaga creek, four miles south of Cardiff. George B. Simpson, collector. 1863.

No. 239. Hamilton group. Specimens collected from loose pieces, half a mile west of village of La Fayette, Onondaga county, N. Y. George B. Simpson, collector. 1863.

No. 240. Hamilton group. Specimens collected from Fall brook, one mile below, and opposite Skaneateles lake. George B. Simpson, collector. 1863.

No. 241. Hamilton group. Cyathophylloid corals, from east shore of Skaneateles lake, three miles from head. George B. Simpson, collector. 1863.

No. 242. Hamilton group. Specimens collected from ravine running into Skaneateles lake, one and a half miles south of Borodino. George B. Simpson, collector. 1863.

No. 243. Hamilton group. Specimens collected from stream running into Skaneateles lake at Apple Tree point, west side, four miles from head. George B. Simpson, collector. 1863.

No. 244. Hamilton group. Specimens collected from stream running into Skaneateles lake at Pray's Point, three miles from head, and between that and a point one mile above; west side. George B. Simpson, collector. 1863.

No. 245. Hamilton group. Specimens collected from ravine, one and a half miles north of Aurora, Cayuga county. George B. Simpson, collector. 1863.

No. 246. Hamilton group. Specimens collected from falls at Carter's mills, four miles north of Aurora, from top of falls. George B. Simpson, collector. 1863.

No. 247. Hamilton group. Specimens collected from ravine running into Skaneateles lake, one and a quarter miles south of Borodino. George B. Simpson, collector. 1863.

No. 248. Hamilton group. Specimens collected from ravine, one and three-quarters miles south of Borodino; east side. George B. Simpson, collector. 1863.

No. 249. Hamilton group. Specimens collected from stream, three-fourths of a mile south of Fabius village. George B. Simpson, collector. 1863.

No. 250. Hamilton group. Specimens collected from a ravine two miles south of Fabius village. George B. Simpson, collector. 1863.

No. 251. Hamilton group. Specimens collected from ravines running into Owasco lake, from the head to four miles down, west side. George B. Simpson, collector. 1863.

No. 252. Hamilton group. Specimens collected from a ravine running into Skaneateles lake three and a half miles below Borodino. George B. Simpson, collector. 1863.

No. 253. Hamilton group. Specimens collected from ravine running into Skaneateles lake, three miles from the head, east side. George B. Simpson, collector. 1863.

No. 254. Tully Limestone. From a quarry northwest of the village of Tully, N. Y. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 255. Tully Limestone. From a quarry and ravine south of the railroad station at Tully, N. Y. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 256. Hamilton group. Collected from loose pieces in the vicinity of Tully, N. Y. R. P. Whitfield and George B. Simpson, collectors. 1863.

No. 257. Chemung group. Red House bridge, on the Atlantic and Great Western railroad, in the town of Salamanca. C. Van Deloo, collector. 1863.

No. 258. Chemung group. From Great Valley, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 259. Chemung group. Three miles north of Olean station, near Erie railroad. C. Van Deloo, collector. 1863.

No. 260. Chemung group. One and a half miles west of Olean station, Erie railroad. C. Van Deloo, collector. 1863.

No. 261. Chemung group. Between Olean and Alleghany stations, New York and Erie railroad. C. Van Deloo, collector. 1863.

No. 262. Chemung group. Three miles north of Olean station, New York and Erie railroad. C. Van Deloo, collector. 1863.

No. 263. Chemung group. Three miles west of Olean station, New York and Erie railroad, in the town of Humphrey, N. Y. C. Van Deloo, collector. 1863.

No. 264. Chemung group. Near Little Genesee, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 265. Chemung group. Three miles south of Olean, Cattaraugus county, N. Y. C. Van Deloo, collector. 1863.

No. 266. Chemung group. Carlton and Alleghany stations, New York and Erie railroad. C. Van Deloo, collector. 1863.

No. 267. Conglomerate. One and a half miles north of Olean village. C. Van Deloo, collector. 1863.

No. 268. Hamilton group. Fall Brook near Geneseo, Livingston county, N. Y. C. Van Deloo, collector. 1864.

No. 269. Hamilton group. Mostly from loose masses in the vicinity of Cooperstown, N. Y. C. Van Deloo, collector. 1864.

No. 270. Conglomerate of the Chemung group. From Fortville, eight miles south of Olean, Alleghany county, N. Y. C. Van Deloo, collector. 1864.

No. 271. Upper Helderberg Limestone. Specimens collected or purchased at Delaware, Ohio, from the quarries at that place. The beds are in the lower part of the group. R. P. Whitfield, collector. 1865.

No. 272. Upper Helderberg Limestone. Specimens collected at the State quarries, Columbus, Ohio, and other quarries near there. R. P. Whitfield, collector. 1865.

No. 273. Upper Helderberg Limestone. Specimens collected from a stone heap near Columbus, Ohio, brought from quarries along the railroad. R. P. Whitfield, collector. 1865.

No. 274. Upper Helderberg Limestone. Specimens, mostly corals, collected at the Falls of the Ohio on the Jeffersonville side. R. P. Whitfield, collector. 1865.

No. 275. Hamilton group. The corals are mostly from West Williams, and the mollusks from Widder; Bosanquet, C. W. John De Cew, collector. 1865.

No. 276. Keokuk Limestone. Specimens collected in the railroad cuts from two to three miles west of New Providence, Indiana. R. P. Whitfield, collector. 1865.

No. 277. Hudson River group. Specimens collected about two miles below Westport, Ky., Ohio river, near the bed of a small stream. R. P. Whitfield, collector. 1865.

No. 278. Hudson River group. Collected opposite Westport, Ky., on the Indiana side, fifteen feet above the water level. R. P. Whitfield, collector. 1865.

No. 279. Hamilton group. Specimens of mollusca which were amongst the corals from West Williams, C. W. J. De Cew, collector. 1865.

No. 280. Hamilton group. Spirifera mucronatus mostly from Widder, C. W. Hall, De Cew and others, collectors. 1865.

No. 281. Oriskany Sandstone. Cayuga township, Canada West. John De Cew, collector. 1866.

No. 282. Upper Helderberg. Canada West. J. De Cew, collector. 1866.

No. 283.* Lower Helderberg. Albany county.

No. 284.* Lower Helderberg. Scutella Limestone. Albany county.

No. 285.* Lower Helderberg. Pentamerus Limestone. Albany county.

No. 286.* Lower Helderberg. Tentaculite Limestone. Schoharie.

No. 287.* Lower Helderberg. Upper Pentamerus. Schoharie.

No. 288.* Lower Helderberg. Shaly Limestone. Schoharie.

No. 289.* Lower Helderberg. Shaly Limestone. Herkimer county, N. Y.

No. 290.* Chazy Limestone. Chazy, N. Y.

No. 291.* Trenton Limestone. Middleville, N. Y.

No. 292.* Trenton Limestone. Tribes Hill, N. Y.

No. 293.* Trenton Limestone. Watertown, N. Y.

No. 294.* Niagara group, Lockport, N. Y.

No. 295.* Black River Limestone. Chazy, N. Y.

No. 296.* Hudson River group. Ballston, N. Y.

No. 297.* Black River Limestone. Watertown, N. Y.

No. 298.* Clinton group. Hartford, N. Y.

No. 299.* Coraline Limestone. Schoharie, N. Y.

No. 300. Hamilton group. From Hamilton (and vicinity), Madison county, N. Y. James Hall, collector. 1844.

No. 301. Hamilton group. Fultonham and vicinity, N. Y. James Hall, collector. 1844.

No. 302. Hamilton group. Summit, Schoharie county, N. Y. James Hall, collector. 1844.

No. 303. Hamilton group. Schoharie, N. Y. James Hall, collector. 1844.

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* Collections made by Prof. James Hall and deposited in the State Cabinet previous to 1855.

No. 304. Hamilton group. Oneonta (loose). J. W. Hall, collector. 1869.

No. 305. Hamilton group. Bed of rock at Emmons, Otsego county. J. W. Hall, collector. 1869.

No. 306. Hamilton group. From cliff on West-kill, two and a half miles northeast of Jefferson, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 307. Hamilton group. One-quarter of a mile west of Jefferson, Schoharie county. J. W. Hall and George B. Simpson, collectors. 1869.

No. 308. Hamilton group. One mile north of Jefferson, on the road to Summit. J. W. Hall and George B. Simpson, collectors. 1869.

No. 309. Hamilton group. Collected from a layer of rock about three or four feet above No. 308 and at the same place. J. W. Hall, collector. 1869.

No. 310. Hamilton group. From loose pieces collected one mile north of Jefferson, on the road to Summit, Schoharie county. J. W. Hall, collector. 1869.

No. 311. Hamilton group. From near Dr. Haven's, Jefferson, Schoharie county. Loose pieces. J. W. Hall and George B. Simpson, collectors. 1869.

No. 312. Chemung group. Loose pieces collected on road, about three miles north of Salamanca, Cattaraugus county, N. Y., on road to Rock City, half a mile from Rock City. R. P. Whitfield, collector. 1869.

No. 313. Conglomerate of the Chemung group. Salamanca, N. Y. Collected from the layer on which is found the *Hippodophycus Cowlesi.* R. P. Whitfield, collector. 1869.

No. 314. Hamilton group. Falls on the stream north of the village of Fultonham, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 315. Hamilton group. Collected at about the middle of the falls on Lawyer's creek, near Fultonham. J. W. Hall and George B. Simpson, collectors. 1869.

No. 316. Hamilton group. From the top of the falls on Lawyer's creek, near Fultonham, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 317. Hamilton group. From loose pieces on road running near stream at Watson, Fultonham, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors, 1869.

No. 318. Hamilton group. From loose pieces on creek at Watsons, Fultonham, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 319. Hamilton group. Collected from creek in Adam's Hollow, Fultonham, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 320. Hamilton group. Collected from Kenhuragara creek near Fultonham, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 321. Hamilton group. Collected at West Fulton on Fultonham road, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 322. Hamilton group. Loose pieces collected from bed of small creek, west side of Schoharie creek, two and a half miles north of Blenheim, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 323. Hamilton group. Cliff, west side of Schoharie creek, one mile north of Blenheim, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 324. Hamilton group. Collected at side of road, west side of Schoharie creek, two and a half miles north of Blenheim, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 325. Hamilton group. Collected from bottom of high cliff on east side of Schoharie creek, one mile below Breakabeen, Schoharie county, N. Y. J. W. Hall and George B. Simpson, collectors. 1869.

No. 326. Hamilton group. From near mouth of Kanuragara creek, west side of Schoharie creek, between Fultonham and Breakabeen, Schoharie county, N. Y. J. W. Hall and George G. Simpson, collectors. 1869.

No. 327. Hamilton group. Collection of 1884. James Hall, collector.

No. 328. Chemung group. Collected at the saw-mill one and a half miles east of Portville village. R. P. Whitfield, collector. 1869.

No. 329. Chemung group. Loose pieces plowed up on hillside northeast of Portville village. R. P. Whitfield, collector. 1869.

No. 330. Chemung Sandstone. Conglomerate, loose at base of hill back of village of Portville, N. Y., on opposite side of river. R. P. Whitfield, collector. 1869.

No. 331. Chemung group. Specimens collected from a hard band of sandstone in the bed of Vandemark's creek, at the railroad bridge, Hobbieville, Alleghany county, N. Y. R. P. Whitfield, collector. 1869.

No. 332. Chemung group. Collected from blocks brought to build bridge piers at Hobbieville, Alleghany county, N. Y. R. P. Whitfield, collector. 1869.

No. 333. Chemung group. Collected from the shales above the gray band at Hobbieville, Alleghany county, N. Y., and along the creek above that place. R. P. Whitfield, collector. 1869.

No. 334. Chemung group. Shale above gray band on Vandemark's creek bed, nearly opposite Belvidere station, in bottom of stream. R. P. Whitfield, collector. 1869.

No. 335. Chemung group. From a gray band found loose in bottom of Vandemark's creek. The bed recognized farther north at Angelica. R. P. Whitfield, collector. 1869.

No. 336. Potsdam Sandstone. Lingula Obolella and trilobites, Keeseville, N. Y. R. P. Whitfield, collector. 1867.

No. 337. Chemung group. From a gray band in bed of stream under dam at Hull's mills near Angelica, N. Y. (|| gray band at Hobbieville). R. P. Whitfield, collector. 1869.

No. 338. Chemung group. Shales above gray band at Hull's mills, Angelica, N. Y. R. P. Whitfield, collector. 1869.

No. 339. Portage group. Collected near Ithaca, and north of Ithaca, near lake shore. James Hall, collector. 1868.

No. 340. Hamilton group. Collected at York, Livingston county. C. Van Deloo, collector. 1865.

No. 341. Hamilton group. Collected at Fall brook near Geneseo, N. Y. C. Van Deloo, collector. 1865.

No. 342. Hamilton group. Two miles east of Geneseo, N. Y. C. Van Deloo, collector. 1865.

No. 343. Hamilton group. Railroad depot at Geneseo, N. Y. C. Van Deloo, collector. 1865.

No. 344. Oriskany Sandstone. Drift specimens collected at Aurora, N. Y. J. W. Hall and C. Van Deloo, collectors. 1867.

No. 345. Hamilton group. Collected on the shore of Cayuga lake, south of Aurora. J. W. Hall and C. Van Deloo, collectors. 1867.

No. 346. Lower Helderberg. Becraft's mountain, Hudson, N. Y. R. P. Whitfield, collector. 1865 or 1866.

No. 347. Chemung group. Upper part of the series exposed at Ithaca, N. Y. James Hall, collector. 1868.

No. 348. Upper Helderberg Limestone. Loose pieces near Hamburg, shore of Lake Erie. C. Van Deloo, collector. 1865.

No. 349. Hamilton group. Collected at Hamburg, on the shore of Lake Erie and vicinity. J. W. Hall and C. Van Deloo, collectors. 1865.

No. 350. Oriskany Sandstone. Collected at Devil's-half-acre, eight miles southwest of Auburn, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 351. Oriskany Sandstone. Collected at a locality five miles east of Union Springs (Springville). J. W. Hall and C. Van Deloo, collectors. 1866.

No. 352. Hamilton group. Collected at Bellona, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 353. Hamilton group. Collected near Lodi landing, Seneca Lake, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 354. Tully Limestone. Collected below Lodi landing, Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 355. Black Shales (Marcellus). Collected two miles below Lodi landing, Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 356. Genesee Slate. Black Stream landing, Seneca Lake. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 357. Hamilton group. Ogden's Ferry, Cayuga Lake. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 358. Genesee Slate. Near Kidder's landing, Cayuga lake. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 359. Hamilton group. Ludlowville, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 360. Hamilton group. Collected at Darien, Genesee county, N. Y. C. Van Deloo, collector. 1865.

No. 361. Hamilton group. Collected at Moscow, Livingston county, N. Y. C. Van Deloo, collector. 1865.

No. 362. Hamilton group. Collected at Bethany, N. Y. C. Van Deloo, collector. 1865.

No. 363. Genesee slate. Three miles south of Mount Morris. C. Van Deloo, collector.

No. 364. Genesee Slate. Collected at Moscow, N. Y. C. Van Deloo, collector. 1865.

No. 365. Drift. Hudson river, etc. Rock stream, west shore of Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 366. Hamilton group. Near Dresden, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 367. Portage group. Four miles south of Penn Yan. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 368. Portage group. Between Rock landing and Rock stream, west shore of Seneca lake, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 369. Genesee Slate. Between Rock stream and Rock landing, west shore Seneca lake. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 370. Hamilton group. Loose pieces. Gilboa, Schoharie county, N. Y. J. W. Hall and Geo. B. Simpson, collectors. 1869.

No. 371. Hamilton group. Earlville, Madison county, N. Y. George B. Simpson, collector. 1871.

No. 372. Hamilton group. Pratt's falls (top of falls) Pompey Hill Onondaga county, N. Y. George B. Simpson, collector. 1871.

No. 373. Hamilton group. Ravine running through village of New Berlin. J. W. Hall and Geo. B. Simpson, collectors. 1870.

No. 374. Catskill group. Richmond quarries. Mt. Upton. J. W. Hall and George B. Simpson, collectors. 1870.

No. 375. Hamilton group. Mt. Upton, White's store. J. W. Hall and George B. Simpson, collectors. 1870.

No. 376. Hamilton group. Darien, N. Y. C. Van Deloo, collector. 1874.

No. 377. Hamilton group. York, Livingston county, N. Y. C. Van Deloo, collector. 1874.

No. 379. Hamilton group. Collected in railroad cut two and a half miles east of Alden station. C. Van Deloo, collector. 1874.

No. 383. Hamilton group. Collected at Cornell's storehouse, west side of Cayuga lake, about eight miles north of Ithaca. J. W. Hall, collector. 1866.

No. 384. Hamilton group. Fossils collected on Coshung creek, Bellona, Yates county, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 385. Hamilton group. Fossils collected at Norton's landing, east side of Cayuga lake, eight miles north of Ithaca. J. W. Hall, collector. 1866.

No. 386. Hamilton group. Specimens collected at Pratt's falls, Onondaga county, N. Y. C. Van Deloo and H. H. Smith, collectors. 1874.

No. 387. Tully Limestone. Fossils collected at Bellona, N. Y. J.W. Hall and C. Van Deloo, collectors. 1866.

No. 388. Oriskany Sandstone. Knox, Albany county, N. Y. James Hall, collector.

No. 390. Chemung group. Fossil plants collected on the west side of Cayuga Lake inlet, about one-quarter of a mile below the railroad depot, on opposite side. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 391. Chemung group. Fossils collected at Mr. Cornell's quarry, one mile northeast of Ithaca, N. Y., also from Cemetery quarry and Cascadilla creek. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 392. Chemung group. Fossils collected at the old inclined plane, one mile southeast of Ithaca, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 393. Chemung group. Fossils collected at Dryden, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 394. Chemung group. Fossils collected on Cayuta creek, Tompkins county, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 395. Portage group. Fossils collected mostly on the lighthouse pier, Ithaca, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 396. Chemung group. Fossils collected at Elmira, N. Y. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 397. Chemung group. Fossils collected at Chemung narrows. J. W. Hall and C. Van Deloo, collectors. 1866.

No. 398. Hamilton group, Hamilton, Madison county, N. Y. Old collection recorded. J. Hall, collector. 1862.

No. 399. Hamilton group. Lamellibranchiata. Cazenovia, N. Y. Old collection recorded. J. Hall, collector. 1862.

No. 400. Hamilton group.? *Specimens collected at and in the vicinity of Waterloo, Iowa. R. P. Whitfield, collector. 1866.

No. 401. Chemung group.? Specimens collected at a locality one and a half miles above Rockford, Iowa, on Lime creek, except the unweathered specimens of Stromatopora which were from the ledges along the creek above the mill. R. P. Whitfield, collector. 1866.

No. 402. Chemung group.? Specimens collected at Hackberry, eight miles above Rockford, Iowa, on Lime creek, in a bed having the same position as that, one and a half miles above Rockford. R. P. Whitfield, collector. 1866.

No. 403. Hamilton group. Specimens collected at Waverly, Iowa, on the bank of the Cedar river, above and below the village. R. P. Whitfield, collector. 1866.

No. 404. Hamilton group. Specimens collected at Independence, Iowa. R. P. Whitfield, collector. 1866.

No. 405. Chemung group. Franklin, Delaware county, N. Y. James Hall, collector. 1862.

No. 405a. Hamilton group.? Near Blenheim, below high hill and south of village. James Hall, collector. 1862.

No. 405b. Chemung group.? Near the summit going from head of Delaware to Blenheim. James Hall, collector. 1862.

No. 407. Portage group. Three miles south of Mount Morris, N. Y. C. Van Deloo, collector.

No. 408. Hamilton group, From Pratt's falls, same side as mills, 100 feet from base. Pompey Hill, Onondaga county, N. Y. George B. Simpson, collector. 1871.

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*Many of them were found loose, but are from the rocks in the immediate vicinity.

No. 409. Hamilton group. From Delphi falls, Delphi, Onondaga county, N. Y. George B. Simpson, collector, 1871.

No. 410. Carboniferous. Keokuk group. Crawfordsville, Indiana. C. Van Deloo, collector. 1867.

No. 411. Carboniferous. Keokuk group. Four miles south of Crawfordsville, Ind., at Sugar creek. C. Van Deloo, collector. 1867.

No. 412. Carboniferous. Keokuk group. Specimens collected at Johnsville, one mile southwest on Offield's creek, near Crawfordsville, Ind. C. Van Deloo, collector. 1867.

No. 413. Carboniferous. Keokuk group. Specimens collected at Black creek, near Crawfordsville, Ind. C. Van Deloo, collector. 1867.

No. 414. Carboniferous. Keokuk group. Specimens collected on the Walnut fork of Sugar creek, four miles from Crawfordsville, Ind. C. Van Deloo, collector. 1867.

No. 415. Chemung group. Rockville, Alleghany county, N. Y. Collected at Lock No. ? from layers of sandstone at the top of the bank, and above the green shales. R. P. Whitfield and C. Van Deloo, collectors. 1869.

No. 416. Chemung group. Rockville, Alleghany county, N. Y., at Lock No. ? from the green shales near the level of canal. R. P. Whitfield and C. Van Deloo, collectors. 1869.

No. 417. Chemung group. Collected at Phillipsburg, Alleghany county, N. Y., just below the dam at mill. R. P. Whitfield and C. Van Deloo, collectors. 1869.

No. 418. Chemung group. Rockville, Alleghany county, N. Y., from a quarry of gray sandstone used for building, situated on the side of a hill, on the opposite side of the creek from the canal, representing the same layer as that found at Hobbieville and Angelica, and below the green shales. R. P. Whitfield and C. Van Deloo, collectors. 1869.

No. 419. Marcellus Shale. Creek at West Avon, N. Y. C. Van Deloo, collector. 1865.

No. 420. Corniferous Limestone. Below mills at West Avon, N. Y. (Some specimens are from the Marcellus Shale). C. Van Deloo, collector. 1865.

No. 421. Hamilton group. Jaycox Run, between Geneseo and Avon, N. Y. C. Van Deloo, collector. 1865.

No. 422. Chemung group. Loose specimens overlying conglomerate at Rock City, three and a half miles north of Salamanca, N. Y. R. P. Whitfield, collector. 1869.

No. 423. Hamilton group. Fossils collected from Sherburne creek, below falls, Chenango county, N. Y. J. W. Hall and George B. Simpson, collectors.

No. 424. Hamilton group. From creek, one mile below Norwich, Chenango county, N. Y. J. W. Hall and George B. Simpson, collectors.

No. 425. Chemung group. Lower part of formation, Ithaca, N. Y. J. W. Hall and George B. Simpson, collectors. 1870.

No. 426. Chemung group. Specimens collected from a bed of conglomerate at Clark's farm near Panama, Chatauqua county, N. Y. James Hall, collector. 1870.

No. 427. Chemung group. Specimens collected from above the conglomerate at Clark's farm, near Panama, N. Y. James Hall, collector. 1870.

No. 428. Hamilton group. Specimens collected at Shurger's glen, near Norton's landing, Cayuga lake, N. Y., half way up the side of the third fall (going up from the lake) eleven and a half feet below the Tully Limestone, Division 2, stratum 10 of section. Herbert H. Smith, collector. 1871.

No. 429. Hamilton group. Specimens collected at Vinegar Brook glen, near Norton's landing, Cayuga lake, N. Y., near the top of the lower fall, about 150 feet below Tully Limestone. Herbert H. Smith, collector. 1871.

No. 430. Hamilton group. Specimens collected at Shurger's glen, near Norton's landing, Cayuga lake, N. Y., from loose fragments fallen from about fifteen feet below the Tully Limestone (Division 3 of section). Herbert H. Smith, collector. 1871.

No. 431. Hamilton group. Same as last.

No. 432. Hamilton group. Specimens collected at Vinegar Brook glen, Norton's landing, Cayuga lake, N. Y., from hard shales, half way up the lower fall. Herbert H. Smith, collector. 1871.

No. 433. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in a layer of hard calcareous rock (about eight inches) and in the fine shale immediately above and below this layer, about twenty-five feet below the Tully Limestone and twenty rods below where the stream falls over it. Herbert H. Smith, collector. 1871.

No. 434. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in the shale about eighteen feet below the Tully Limestone, and immediately below the fall formed by that rock. (Twelfth layer, third division below Tully Limestone.) Herbert H. Smith, collector. 1871.

No. 435. Hamilton group. Specimens collected at Ludlowville, Tompkins county, N. Y., in the shale, about twenty feet below the Tully Limestone. In a glen formed by a small brook which flows

into Ludlowville creek on the south side, nearly opposite the village, about half way up the glen. Herbert H. Smith, collector. 1871.

No. 436. Hamilton group. Specimens collected in the fine trilobite shales about twenty-five feet above the Encrinal Limestone. Shurger's glen, Norton's landing, Cayuga lake, N. Y. Herbert H. Smith, collector. 1871.

No. 437. Hamilton group. Specimens collected from loose fragments fallen from about fifteen feet below the Tully Limestone, Shurger's glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

No. 438. Hamilton group. Specimens collected at the lower fall, Vinegar Brook glen, Norton's landing, Cayuga lake. Herbert H. Smith, collector. 1871.

No. 439. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, in the hard shale about twelve feet below the Tully Limestone. (Division 2, stratum 10 of section.) Herbert H. Smith, collector. 1871.

No. 440. Hamilton group. Specimens collected at the middle fall, Shurger's glen, Norton's landing, Cayuga lake, N. Y. Herbert H. Smith, collector. 1871.

No. 441. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, N. Y., in loose fragments fallen from strata lying twenty to thirty feet below the Tully Limestone. Herbert H. Smith, collector. 1871.

No. 442. Hamilton group. Specimens collected at Ludlowville, Tompkins county, N. Y., in a mass of rock, fallen from about thirty feet below the Tully Limestone, below the lower bridge. Herbert H. Smith, collector. 1871.

No. 443. Hamilton group. Specimens collected on the east shore of Cayuga lake, N. Y., two miles south of Norton's landing, in the fine shale immediately below the Tully Limestone. Herbert H. Smith, collector. 1871.

No. 444. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, N. Y., in the coarse shales about twelve feet below the Tully Limestone, and just below the falls formed by that rock. Herbert H. Smith, collector. 1871.

No. 445. Hamilton group. Specimens collected at Vinegar Brook glen, Norton's landing. Cayuga lake, N. Y., in a loose fragment of rock probably fallen from about 100 feet below the Tully Limestone. Herbert H, Smith, collector. 1871.

No. 446. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, N. Y., in the shale about fifteen feet

below the Tully Limestone, and at the foot of the fall, over that rock. Herbert H. Smith, collector. 1871.

No. 447. Hamilton group. Specimens collected from a loose fragment, fallen from about five feet below the Tully Limestone, near the falls over that rock. Shurger's glen, Norton's landing, Cayuga lake, N. Y. Herbert H. Smith, collector. 1871.

No. 448. Hamilton group. Specimens collected at the lower fall. Vinegar Brook glen, Nortons's landing, Cayuga lake, N. Y. Herbert H. Smith, collector. 1871.

No. 449. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, N. Y. In the shale immediately below the Tully Limestone at the fall over that rock. Herbert H. Smith, collector. 1871.

No. 450. Catskill group. Specimens collected from a thin bed of calcareous rock in the Catskill group on Seeley creek (branch of Lamb's creek), four miles northwest of Mansfield, Tioga county, Penn. They occur in bed No. 11, section No. 1. Andrew Sherwood, collector. 1871.

No. 451. Catskill group. Specimens from a fish-bed on Seeley creek (branch of Lamb's creek) four miles northwest of Mansfield, Tioga county, Penn. They occur in bed No. 19, section No. 1. Andrew Sherwood, collector. 1871.

No. 452. Catskill group. Specimens from the west bank of the Tioga river, near the mouth of Lamb's creek, three miles north of Mansfield, Tioga county, Penn. They occur in bed No. 5, section No. 3. Andrew Sherwood, collector. 1871.

No. 453. Catskill group. West bank of the Tioga river, three miles north of Mansfield, Tioga county Penn. Bed No. 4, section, No. 3. Andrew Sherwood, collector. 1871.

No. 454. Catskill group. West bank of Tioga river, three miles north of Mansfield, Penn. Bed No. 14, section No. 3. Andrew Sherwood, collector. 1871.

No. 455. Chemung group. Specimens from bed No. 1, section No. 1, four miles northwest of Mansfield, Penn. Andrew Sherwood, collector. 1871.

No. 456. Catskill group. West bank of Tioga river, three miles north of Mansfield, Penn. Bed No. 3, section No. 3. Andrew Sherwood, collector. 1871.

No. 457. Chemung group. Specimens from Kelly creek, two miles northeast of Mansfield, Tioga county, Penn. From bed No. 9, section No. 4. Andrew Sherwood, collector. 1871.

No. 458. Chemung group. Specimens from Kelly creek, two miles northeast of Mansfield, Penn. Found in bed No. 5, section No. 4. Andrew Sherwood, collector. 1871.

No. 459. Chemung group. Specimens from railroad cut, east of Tioga village, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 460. Chemung group. Specimens from a small stream coming into Tioga river from the west, two miles north of Mansfield, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 461. Chemung and Catskill groups. Lithological specimens from Seeley creek (branch of Lamb's creek), four miles northwest of Mansfield, Tioga county, Penn. (The numbers in ink on the specimens correspond to the numbers on Section No. 1.) Andrew Sherwood, collector. 1871.

No. 462. Hamilton group. Specimens collected in the fine shale, immediately below the Tully Limestone, two miles south of Norton's landing, Cayuga lake, N. Y. (near where the Tully Limestone runs down into the lake). Herbert H. Smith, collector. 1871.

No. 463. Hamilton group. Specimens collected at Vinegar Brook glen, Norton's landing, Cayuga lake, N. Y., in the dark shales about 100 feet below the Tully Limestone. Herbert H. Smith, collector. 1871.

No. 464. Hamilton group. Specimens collected on the shore of Cayuga lake, N. Y., in the shale immediately below the Tully Limestone, two miles north of Norton's landing. Herbert H. Smith, collector. 1871.

No. 465. Hamilton group. Specimens collected on the east shore of Cayuga lake, N. Y., at various points, from half a mile to two miles south of Norton's landing. Herbert H. Smith, collector. 1871.

No. 466. Hamilton group. Specimens collected on the west shore of Cayuga lake, opposi Norton's landing. Herbert H. Smith, collector. 1871.

No. 467. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, N. Y., in the dark shale about 120 feet below the Tully Limestone. (Trilobite shales.) Herbert H. Smith, collector. 1871.

No. 468. Hamilton group. Specimens collected at Shurger's glen, Norton's landing, Cayuga lake, N. Y., in the shale about 100 feet below the Tully Limestone. Herbert H. Smith, collector. 1871.

No. 469. Hudson River group. Specimens collected near Cincinnati, Ohio. Herbert H. Smith, collector.

No. 469. Catskill group. Oneonta Sandstone. Specimens collected at Richmond's quarry, near Mount Upton, N. Y. Andrew Sherwood, collector. 1871.

No. 470. Chemung group. Neighborhood of Mansfield, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 471. Chemung group. Specimens collected at Erwin Centre, Steuben county, N. Y. Andrew Sherwood, collector. 1871.

No. 472. Chemung group. Specimens collected at Mansfield, Tioga, county, Penn. Andrew Sherwood, collector. 1871.

No. 473. Chemung group. Collected between Corning and Elmira, N. Y. Andrew Sherwood, collector. 1871.

No. 474. Catskill group. Specimens collected on the east bank of the Susquehanna above, and near Towanda, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 475. Conglomerate. Below Millstone grit, half way between Bradford and Farmer's valley, McKean county, Penn. Andrew Sherwood, collector. 1871.

No. 476. Hamilton, Orange county, near Monroe. C. Van Deloo, collector. 1870.

No. 477. Conglomerate. South of Smethport, Penn. C. Van Deloo, collector. 1870.

No. 477½. Conglomerate. Higher bed. South of Smethport, Penn.

No. 478. Conglomerate. West of Smethport, Penn., Olean road, Alton road. C. Van Deloo, collector. 1870.

No. 479. Conglomerate. Southeast of Smethport, Penn. C. Van Deloo, collector. 1870.

No. 480+. Conglomerate. Higher bed, west of Smethport, Penn., Olean road. C. Van Deloo, collector.

No. 480. Chemung group. East of Smethport, Penn. C. Van Deloo, collector. 1870.

No. 481. Conglomerate. South of Grant station and Panama, Penn., C. Van Deloo, collector. 1870.

No. 482. Waverly Sandstone. Oil City, Penn. C. Van Deloo, collector. 1870.

No. 483. Waverly Sandstone. Between Millers and Shafers. C. Van Deloo, collector. 1870.

No. 484. Shales and Sandstone above conglomerate, south of Panama, N. Y., and north of Pine Valley, Penn. James Hall, collector. 1870.

No. 485. Chemung group. Immediately above the conglomerate. Roadside southwest of Panama, N. Y. James Hall, collector, 1870.

No. 486. Chemung group. Road from Watkins to Elmira and neighborhood of Elmira etc., N. Y. C. Van Deloo, collector. 1870.

No. 487. Chemung group. North of Elmira and at Horseheads. C. Van Deloo, collector. 1870.

No. 488. Chemung group. Corning, N. Y. C. Van Deloo, collector. 1870.

No. 489. Chemung group. North of, and near Elmira, N. Y. C. Van Deloo, collector. 1870.

No. 490.* Chemung group. Near Elmira? C. Van Deloo, collector. 1870.

No. 491. Chemung group. Loose fragments at Clark's farm, two miles southeast of Panama, Chautauqua county, N. Y. James Hall, collector. 1870.

No. 492. Chemung group. Loose fragments at Clark's farm, near Panama, N. Y. Specimens evidently from layer near by. James Hall, collector. 1870.

No. 493. Chemung group. Clark's farm, near Panama, N. Y., loose in creek on east side of valley. James Hall, collector. 1870.

No. 494. Chemung group. From boulder, on road to Clark's farm, east side of Panama, N. Y. James Hall, collector. 1870.

No. 495. Chemung group. Roadside south of Panama, Chautauqua county, N. Y. (above conglomerate). James Hall, collector. 1870.

No. 496. Hamilton group. From "the Horn rock," Skaneateles lake, three miles from head of lake. J. W. Hall and George B. Simpson collectors. 1872.

No. 497. Hamilton group. From falls opposite Borodino, Skaneateles lake, N. Y. J. W. Hall and George B. Simpson. 1872.

No. 498. Hamilton group. From Otisco lake, three miles east of Borodino. J. W. Hall and George B. Simpson, collectors. 1872.

No. 499. Hamilton group. From bed of creek entering Skaneateles lake at Borodino. J. W. Hall and George B. Simpson, collectors. 1872.

No. 500. Hamilton group. Pratt's falls, Onondaga county, N. Y. J. W. Hall and George B. Simpson, collectors. 1872.

No. 502. Clinton group. Specimens collected at Soldiers' Home quarries, Dayton, Ohio. R. P. Whitfield, collector. 1873.

No. 503. Hudson River group. Specimens collected on Vine Street hill, at Cincinnati, Ohio. R. P. Whitfield, collector. 1873.

No. 504. Niagara group. Fossils collected at Yellow springs, Ohio, (mostly *Pentamerus oblongus*). R. P. Whitfield, collector. 1873.

No. 505. Marcellus Shale. Avon, N. Y. James Hall, collector.

No. 506. Marcellus Shale. LeRoy, N. Y. James Hall, collector.

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*Some marked 490 have been identified as Hamilton and those recognized are marked 490a. These are probably from drift specimens of the Hamilton rock.

No. 507. Hudson River group. Collected at and in the vicinity of Waynesville, Ohio. (Part of them obtained from Mr. Jesse Vanduser, of Waynesville). R. P. Whitfield, collector. 1873.

No. 508. Hudson River group. Collected at Cincinnati, Ohio. Herbert H. Smith, collector. 1871.

No. 509. Tentaculite Limestone. From stone wall, one mile west of Clockville, Madison county, N. Y. George B. Simpson, collector. 1873.

No. 510. Onondaga Salt group. Hopper-shaped crystals and other geological specimens, from three-fourths mile southeast of Clockville, N. Y. George B. Simpson, collector. 1873.

No. 511. Chemung group. Fossils collected at the old inclined plane, one mile southeast of Ithaca, N. Y. C. Van Deloo, collector. 1874.

No. 512. Lower Helderberg and Waterlime, Crinoids and Eurypterus. Jerusalem hill, Litchfield, N. Y. George B. Simpson, collector. 1873.

No. 513. Fossils from a small stream coming into Towanda creek from the west, one mile south of Canton, Bradford county, Penn. The shaly specimens came from the solid rocks above the Mansfield iron ore to less than forty feet from the bottom of the old bed. They are all supposed to have come from above the conglomerate. A. Sherwood, collector. 1871.

No. 514. Hamilton group. Specimens from two large loose rocks on the Catskill turnpike, two or three miles east of Stamford, Delaware county, N. Y. A. Sherwood, collector. 1871.

No. 516. Chemung group. Specimens from Sullivan township, Tioga county, Penn. Supposed to have come from below the conglomerate. A. Sherwood, collector. 1871.

No. 518. Chemung group. Specimens from Belmont, Alleghany county, N. Y. Horizon below the conglomerate. A. Sherwood, collector. 1871.

No. 519. Chemung group. Specimens from Belvidere, Alleghany county, N. Y. Horizon below the conglomerate. A. Sherwood, collector. 1871.

No. 520. Chemung group. Specimens from Mansfield, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 521. Chemung group. Specimens from Mansfield, Tioga county, Penn. Supposed to have come from below the conglomerate. A. Sherwood, collector. 1871.

No. 522. Specimens from loose stones on the side of the America mountains above the fish bed at Redrock. Have come from above the Old Red or are drifted specimens. A. Sherwood, collector. 1871.

No. 523. Chemung group. Specimens from Sullivan township, Tioga county, Penn. Supposed to have come from below the conglomerate. Andrew Sherwood, collector. 1871.

No. 524. Upper Chemung group. Specimens from Sullivan township, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 525. Chemung group. Specimens from the upper Chemung, at Mansfield, Penn. A. Sherwood, collector. 1871.

No. 526. Chemung group. Specimens from Sullivan township, Tioga county, Penn., supposed to have come from below the conglomerate. Andrew Sherwood, collector. 1871.

No. 527. Chemung group. Specimens from Lawrenceburg, Tioga county, Penn., supposed to be from below the conglomerate. Andrew Sherwood, collector. 1871.

No. 528.* Chemung group. [?] Specimens from the top of the hill, one mile east of Charlottsville, Schoharie county, N. Y. Horizon supposed to be above the conglomerate, or about the same as Mt. Upton. Sherwood, collector. 1871.

No. 529. Chemung group. Beeween Monroeton or Monroe Corners and Towanda, Bradford county, Penn., supposed to be below the conglomerate. Among these are specimens of *spirifera mesastrialis* which is always restricted to lower beds of Chemung. Andrew Sherwood, collector. 1871,

No. 529¼. Chemung group. Specimens from Great Bend, Susquehanna county, Penn. Supposed to be above conglomerate. Andrew Sherwood, collector. 1871.

No. 529½. Chemung group. Orwell township, Bradford county, Penn. Below conglomerate. Andrew Sherwood, collector. 1871.

No. 529¾. Chemung group. Le Raysville, Pike township, Bradford county, Penn. Transition rocks between Chemung and Catskill. Above conglomerate. Andrew Sherwood, collector. 1871.

No. 530. Chemung group. Ferns and Fucoids from Montrose, Susquehanna county, Penn., from above the conglomerate. Andrew Sherwood, collector. 1871.

No. 531. Chemung group. Two miles southwest of Monroe Corners, Bradford county, Penn. Near the conglomerate. Andrew Sherwood. collector. 1871.

No. 531½. Chemung group. Near Le Roy, Bradford county, Penn. Horizon of the conglomerate. Andrew Sherwood, collector. 1871.

No. 532. Chemung group, [|| Hamilton group]. Two miles west

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* Probably all those labeled 528 are of Hamilton age, and those observed and identified as such are labeled 528a. The comparison with beds at Mount Upton, indicates a horizon below Chemung. H.

of Morris, Otsego county, N. Y., top of hill on road to South New Berlin. (Most, if not all the specimens are identical with those of the Hamilton group.) Andrew Sherwood, collector. 1871.

No. 533. Chemung group. Mansfield, Tioga county, Penn. Below the conglomerate. Andrew Sherwood, collector. 1871.

No. 534. Chemung group. Ithaca, N. Y. Andrew Sherwood, collector. 1871.

No. 535. Chemung and Hamilton groups. Specimens from Norwich, N. Y. Andrew Sherwood, collector. 1871.

No. 536. Chemung group. Between Marathon and Hartford, Cortland county, N. Y. Andrew Sherwood, collector. 1871.

No. 537. Hamilton group. Norton's landing, Cayuga lake, N. Y. Andrew Sherwood, collector. 1871.

No. 538. Chemung group. From Mansfield, Tioga county. Penn. Specimens mostly small Pterinea, below conglomerate. Andrew Sherwood, collector. 1871.

No. 539. Catskill group. Red Rock near Blossburg, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 540. Catskill group. Old red, Fish remains, Seeley's creek, three miles northwest of Mansfield, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 541. Catskill group. At Ogden's Corners, Union township, Tioga county, Penn. Fish remains and Plants. Andrew Sherwood, collector. 1871.

No. 542. Chemung group. Cook's creek, Lindley township, Steuben county, N. Y. Supposed to be below the conglomerate. Andrew Sherwood, collector, 1871.

No. 543. Conglomerate near base, mill stream north and west of Panama, Chautauqua county, N. Y., at base of 80 feet exposure. James Hall, collector. 1871.

No. 544. Chemung group. Kelley's creek near Mansfield, Tioga county, Penn. Below the conglomerate. Andrew Sherwood, collector. 1871.

No. 545. Upper Chemung group. From tunnel on Midland railroad, two miles east of Hancock, Delaware county, N. Y. Andrew Sherwood, collector. 1871.

No. 546. Fish remains, shells, etc., from the Mansfield iron-ore bed, two and a half miles south of Canton, Bradford county, Penn., on Towanda creek and on land of Mr. Sullard. They are supposed to have come from above the conglomerate. Andrew Sherwood, collector. 1871.

No. 546*a*. (Mem.) The iron-ore and fish remains are marked 546. The Grammysia and Productus, not in iron, are marked 546*a*. 1871.

No. 547. Catskill group. Specimens from Lamb's creek, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 548. Specimens from Tioga, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 549. Chemung group. Specimens from Mansfield, Tioga county, Penn. Below the conglomerate. Andrew Sherwood, collector. 1871.

No. 550. Hamilton group. Specimens collected at Norton's landing, Cayuga lake. C. Van Deloo, collector. 1874.

No. 551. Hamilton group. Specimens collected one and a half miles north of the railroad station, west side of Cayuga lake, near Ithaca, N. Y. C. Van Deloo, collector. 1874.

No. 552. Portage group. East side of Cayuga lake, near Ithaca, N. Y. C. Van Deloo, collector. 1874.

No. 553. Goniatite Limestone. Specimens from near Manlius, N. Y. Herbert H. Smith, collector. 1873.

No. 554. Hamilton group. Specimens collected at Delphi, N. Y. C. Van Deloo and H. H. Smith, collectors. 1873.

No. 554*a*. Hamilton group. Specimens collected at Delphi, N. Y. J. W. Hall and George B. Simpson, collectors. 1875.

No. 555. Specimens illustrating a section of the strata of the southern counties of New York. James Hall and George B. Simpson, collectors. 1875.

No. 556. Hamilton group. Pratt's falls, upper beds. George B. Simpson, collector. 1873 and 1875.

No. 557. Hamilton group. Ludlowville, Cayuga county, N. Y. George B. Simpson, collector. 1872.

No. 558. Hamilton group. Norwich, Chenango county, N. Y. George B. Simpson, collector. 1875.

No. 559. Hamilton group. Fulton and Summit. George B. Simpson, collector. 1875.

No. 560. Lower Pentamerus Limestone. Clarkesville, Albany county, N. Y. L. E. Brown and C. Van Deloo, collectors. 1876.

No. 561. Corniferous Limestone. Clarkesville, Albany county, N. Y. L. E. Brown and C. Van Deloo, collectors. 1876.

No. 562. Schoharie Grit. Clarkesville, Albany county, N. Y. L. E. Brown and C. Van Deloo, collectors. 1876.

No. 563. Tentaculite Limestone. Clarkesville, Albany county, N. Y. L. E. Brown and C. Van Deloo, collectors. 1876.

No. 564. Chemung group. Lawrenceville, Tioga county, Penn. Horizon below the conglomerate. Andrew Shewood, collector. 1871.

No. 565. Upper Chemung group. Specimens from one and a half miles east of Bennett's hotel, in the road and near the center of Auburn township, Susquehanna county, Penn. Andrew Sherwood, collector. 1870.

No. 566. Chemung group. Specimens from Addison and Bath, Steuben county, N. Y. Andrew Sherwood, collector. 1871.

No. 567. Chemung group. From Adrian on the Canisteo river, Steuben county, N. Y. Andrew Sherwood, collector. 1871.

No. 567*a*. Chemung group. Railroad cut three miles west of Alleghany, Cattaraugus county, N. Y. Andrew Sherwood, collector. 1871.

No. 567*b*. Chemung group. Elm Valley, Alleghany county, N. Y. Andrew Sherwood, collector. 1871.

No. 567*c*. Chemung group. Belmont, Alleghany county, N. Y. Andrew Sherwood, collector. 1871.

No. 567*d*. Chemung group. Vespertine, head of Rock run, five miles east of Alleghany river, McKeon county, Penn. Andrew Sherwood, collector. 1871.

No. 567*e*. Chemung group. Cuba, Alleghany county, N. Y. Andrew Sherwood, collector. 1871.

No. 567*f*. Specimens illustrating the strata between Ludlowville and Ithaca, on the shore of Cayuga lake. Andrew Sherwood, collector. 1871.

No. 567*g*. Chemung group. Howard, Steuben county, N. Y. Andrew Sherwood, collector. 1871.

No. 568. Chemung group. Specimens from Mehoopany, Wyoming county, Penn. Andrew Sherwood, collector. 1871.

No. 568*a*. Chemung group. On Phillips creek, three miles east of Belmont, Alleghany county, N. Y. Horizon supposed to be below the conglomerate. Andrew Sherwood, collector. 1871.

No. 568*b*. Chemung group. Rummerfield Creek, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 568*c*. Chemung group. From the top of a hill at Rummmerfield creek, Wysox township, Bradford county, Pa. Andrew Sherwood, collector. 1871.

No. 568*d*. Chemung group. Windham township, Wyoming county, Penn. Andrew Sherwood, collector. 1871.

No. 569. Chemung group. Bakers Bridge, Alleghany county, N. Y. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

No. 569*a*. Upper Chemung group. Specimens from the outcrop in the road on top of a hill, three or four miles northeast of Laceyville, in Auburn township, Susquehanna county, Penn. Andrew Sherwood, collector. 1871.

No. 570. Chemung group. Lindley, Steuben county, N. Y. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

No. 570*a*. Chemung group. From below the Millstone grit. Half way between Bradford and Farmers' Valley, McKean county, Penn. Andrew Sherwood, collector. 1871.

No. 570*b*. Chemung group. Specimens of Dictyophyton, Bath, Steuben county, N. Y. Andrew Sherwood, collector. 1871.

No. 570*c*. Chemung group. Specimens from Bath, Steuben county, N. Y. Andrew Sherwood, collector. 1871.

No. 570*d*. Chemung group. Specimens from Tioga, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 571. Upper Chemung group. Specimens from below the conglomerate at Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 571*a*. Catskill group. Specimens from Tioga, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 572. Chemung group. Specimens from Erwin Center, Steuben county, N. Y. Andrew Sherwood, collector. 1871.

No. 573. Chemung group. Fossils from bank of the Chemung river between Corning and Elmira, N. Y. Andrew Sherwood, collector. 1871.

No. 574. Chemung group. Fossils from Corning and Painted Post, N. Y. Andrew Sherwood, collector. 1871.

No. 575. Chemung group. Fossils from Chemung river between Elmira and Waverly. Andrew Sherwood, collector. 1871.

No. 575*a*. Chemung group. Fish remains from Smithfield, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 575*c*. Chemung group. Fossils from between Ulster and Towanda. Andrew Sherwood, collector. 1871.

No. 575*d*. Chemung group. Fossils from the so-called silver mines, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 576. Chemung group. Fossils from strata at the mouth of Wysox creek, Wysox township, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 577. Chemung group. Fossils from the Chemung at Vestal, Broome county, N. Y. Andrew Sherwood, collector. 1871.

No. 578. Chemung group. Two miles south of Nichols, Tioga county, N. Y. Andrew Sherwood, collector. 1871.

No. 578*a*. Chemung group. From Oneonta, Otsego county, N. Y. Andrew Sherwood, collector. 1871.

No. 578*c*. Chemung group. Two miles west of North New Berlin, Chemung county, N. Y. Andrew B. Sherwood, collector. 1871.

No. 578*d*. Chemung group. Specimens from Binghamton township, Broome county, N. Y. Andrew Sherwood, collector. 1871.

No. 578*e*. Chemung group. From the north part of Rome township, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 579. Catskill group. Specimens from Mansfield, Penn. Andrew Sherwood, collector. 1871.

No. 580. Chemung group. Specimens from Mansfield, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 581. Upper Chemung group. Specimens from a bed of iron ore at Austinville, Columbia township, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 582. Chemung group. From near the township line west of Smithfield, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 582*a*. Chemung group. From Smithfield, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 582*c*. Chemung group. Specimens from localities between Mitchels and Columbia Cross-roads. Andrew Sherwood, collector. 1871.

No. 583. Chemung group. Specimens from Columbia township, Bradford county, Penn. Andrew Sherwood, collector. 1871.

No. 584. Chemung group. Specimens from Roseville, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 584*a*. Chemung group. Ulster township, Bradford county, Penn., (near Hemlock run). Andrew Sherwood, collector. 1871.

No. 585. Chemung group. Specimens on Cook's creek, Lindley township, Steuben county, N. Y. Horizon below conglomerate. Andrew Sherwood, collector. 1871.

No. 586. Upper Chemung group. Specimens from Mansfield, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 587. Upper Chemung group. Specimens from Charleston township, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 588. Upper Chemung. Sullivan township, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 589. Chemung group. Specimens from two miles west of Lawrenceville village, Tioga county, Penn., in an excavation for a railroad. Horizon supposed to be below the conglomerate. Andrew Sherwood, collector. 1871.

No. 590. Upper Chemung group. Specimens from a loose mass of rock taken from the excavation for a railroad two miles west of Lawrenceville, Tioga county, Penn. The rock is supposed to have come from the top of the mountain one or two miles to the north, where there is said to be more of the same kind. Horizon unknown, but

supposed to be near the Chemung conglomerate. Andrew Sherwood, collector. 1871.

No. 591. Chemung group. Gorton's quarry, Corning, Steuben county, N. Y. Horizon below the conglomerate. Andrew Sherwood, collector. 1871.

No. 592. Chemung group. Same as last.

No. 593. Chemung group. Specimens from lands of Thomas Knapp, two miles west of Lawrenceville, Tioga county, Penn. Horizon 500 feet below top of Chemung. Andrew Sherwood, collector. 1871.

No. 594. Chemung group. Morgan's creek, Lindley township, Steuben county, N. Y. Horizon below the conglomerate. 1871.

No. 595. Chemung group. From the farm of Jacob Zahn in northern border of Lindley township, Steuben county, N. Y. Horizon supposed to be the same as the Chemung conglomerate. Andrew Sherwood, collector. 1871.

No. 596. Chemung group. Specimens representing the physical character of the rocks on a small creek on lands of Thomas Knapp, two miles west of Lawrenceville, Tioga county, Penn. Andrew Sherwood, collector. 1871.

No. 597. Vespertine. Specimens representing the physical character of the rocks (supposed to be Vespertine) on the Norway ridge in the south border of Woodhull township, Steuben county, N. Y,, and on lands of Leander Clark and of Mr. McCasslin. They are mostly surface rocks as the solid bed comes to the surface in but few places. The following is a key to the number on the specimens. Andrew Sherwood, collector. 1871:

1. From loose rocks on top of hill.
2. From loose rocks near top of hill.
3. From loose rocks fifty or sixty feet below top of hill.
4. From loose rocks seventy feet below top of hill.
5. From loose rocks eighty feet below top of hill.
6. From an outcrop of solid, 100 feet below top of hill.
7. From an outcrop of solid, 100 to 150 feet below top of hill.
8. From loose rocks 200 feet below top of hill.

No. 598. Hamilton group. On a small creek, one mile north of Gilbertsville, Otsego county, N. Y. Andrew Sherwood, collector. 1871.

No. 599. Chemung group. Two miles above Chenango Forks, on the road to Norwich. Andrew Sherwood, collector. 1871.

No. 599*a*. Chemung group. Miscellaneous specimens from Steuben, Alleghany and Cattaraugus counties, N. Y., and McKean and Potter counties, Penn. Andrew Sherwood, collector. 1871.

The numbers 600–613 (in orange tickets) designate the geological formations and localities of a collection of fossils purchased of John Gebhard, Jr., in 1872. Those marked Pickett collection, were purchased of Mr. Pickett, late of Rochester, N. Y., and those marked Simms collection were purchased of Mr. Jeptha Simms, late of Fort Plain, N. Y. These have all been incorporated into the general collection, though each specimen is marked with a printed ticket bearing the name of the original owner. Other numbers, to 847 inclusive, record various miscellaneous collections which had accumulated in the State Cabinet previous to 1866.

All the numbering, recording, etc., from 600 to 847, are in the handwriting of Mr. J. A. Lintner, while assistant in the State Cabinet.

No. 600. Hudson River group. Schoharie county, N. Y.

No. 601. Coralline group. Schoharie county, N. Y.

No. 601*a*. Waterlime group. Schoharie county, N. Y.

No. 602. Tentaculite Limestone. Schoharie county, N. Y.

No. 603. Lower Pentamerus Limestone. Schoharie county, N. Y.

No. 604. Shaly Limestone. Schoharie county, N. Y.

No. 605. Upper Pentamerus Limestone. Schoharie county, N. Y.

No. 606. Oriskany Sandstone. Schoharie county, N. Y.

No. 607. Schoharie Grit. Schoharie county, N. Y.

No. 608. Onondaga Limestone. Schoharie county, N. Y.

No. 609. Corniferous Limestone. Schoharie county, N. Y.

No. 610. Marcellus Shale. Schoharie county, N. Y.

No. 611. Hamilton group. Schoharie county, N. Y.

No. 612. Portage group. Schoharie county, N. Y.

No. 613. Chemung group. Schoharie county, N. Y.

No. 614. Lower Helderberg group. Gebhard collection, old and new, and miscellaneous collections of James Hall and assistants.

No. 615. Oriskany Sandstone. Seneca and Cayuga counties, N. Y., Pickett collection.

No. 616. Lower Helderberg Limestone. Schoharie county, N. Y. Simms collection.

No. 617. Upper Helderberg group. Schoharie county, N. Y. Gebhard collection (1872).

No. 618. Hamilton group. Schoharie county, N. Y. Simms collection.

No. 619. Trenton group. Simms collection.

No. 620. Trenton group. Herkimer county, N. Y. Simms collection.

No. 621. Trenton group. Fort Plain, N. Y. Simms collection.

No. 622. Trenton group. Fonda, N. Y. Simms collection.

No. 623. Trenton group. Trenton Falls, N. Y. Simms collection.

No. 624. Utica Slate. Herkimer and Montgomery counties, N. Y. Simms collection.

No 625. Niagara group. Lockport, N. Y. Simms collection.

Miscellaneous collections of John Gebhard (old collection, purchased previously to 1872); and of James Hall and assistants.

No. 626. Trenton Limestone.

No. 627. Hudson River group.

No. 628. Hudson River group.

No. 629. Medina Sandstone.

No. 630. Clinton group.

No. 631. Niagara group.

No. 632. Coralline Limestone. Schoharie, N. Y.

No. 633. Onondaga Salt group. Schoharie, N. Y.

No. 634. Tentaculite Limestone. Schoharie, N. Y.

No. 635. Lower Pentamerus Limestone. Schoharie, N. Y.

No. 636. Shaly Limestone. Schoharie, N. Y.

No. 637. Upper Pentamerus Limestone. Schoharie county, N. Y.

No. 638. Oriskany Sandstone. Schoharie county, N. Y.

No. 639. Upper Helderberg group. Schoharie county, N. Y.

No. 640. Hamilton group. Fragments of Psaronius and other fossil plants from Gilboa.

No. 641. Portage group.

No. 642. Chemung group.

No. 643. Hudson River group. Cincinnati, Ohio. Pickett collection.

No. 644. Hudson River group. Oswego county, N. Y. Pickett collection.

No. 645. Clinton group. Rochester, N. Y. Pickett collection.

No. 646. Niagara group. Rochester, N. Y. Pickett collection.

No. 648. Hamilton group. Principally Ontario and Livingston counties. Pickett collection.

No. 649. Upper Helderberg group. Corals from the neighborhood of Caledonia, N. Y. Pickett collection.

No. 650. Carboniferous and other fossils from Missouri, 1873. C. Veatch, in exchange.

No. 651. Graptolites. James Hall's collection. South side of Mohawk river west of and near Amsterdam, N. Y. 1873.

No. 652. Eozoon Canadense. Chelmsford, Mass. Professor L. B. Burbank.

No. 653. Hamilton group. Richmondville. Gebhard collection.

No. 654. Trenton Limestone. Gebhard collection. 1872.

No. 655. Hudson River group. Western States. Gebhard collection.

No. 656. Medina Sandstone. Gebhard collection.

No. 657. Clinton group. Gebhard collection.

No. 658. Niagara group. Gebhard collection.

No. 659. Upper Helderberg Limestone. Williamsville, Erie county, N. Y. James Hall, collection.

No. 660. Marcellus Shale. Goniatite Limestone, Manlius, Onondaga county, N. Y. James Hall, collection.

No. 661. Birdseye Limestone. Phytopsis tubulosum. Gebhard collection.

No. 663. Calcites. Calcareous tufa. Chittenango, N. Y.

No. 664. Upper Helderberg group. Falls of the Ohio. S. S. Lyon, collector.

No. 665. Coal Measures. Edmondson county, Kentucky. S. S. Lyon, collector.

No. 666. Onondaga Salt group. Manlius, N. Y.

No. 667. Waterlime group. Cobleskill, N. Y.

No. 668. Niagara group. Lockport, N. Y.

No. 669. Laurentian system [??]. Rossie, N. Y.

No. 670. Calcite, Ball's and other caves. Schoharie and vicinity.

No. 671. Fanklinite. New Jersey.

No. 672. Sulphate Baryta. Pillar Point opposite Sacketts Harbor, N. Y.

No. 673. Sulphate Baryta. Cheshire, Conn.

The specimens recorded below, under the numbers 674 to 680, are from old collections of Professor Hall made previous to 1855.

No. 674. Hamilton group. Summit, Schoharie county, N. Y.

No. 675. Tully Limestone. Tully, N. Y.

No. 676. Hamilton group. Pavilion, Genesee county, N. Y.

No. 677. Hamilton group. Seneca lake, N. Y.

No. 678. Hamilton group. Genesee county, N. Y.

No. 679. Hamilton group. Lake Erie shore to Darien, N. Y.

No. 680. Hamilton group. York, Livingston county, N. Y.

No. 690. Trenton group. Emmons collection.

No. 691. Utica Slate. Gebhard collection.

No. 692. ——— ———. Lawrence Brook, N. J.

No. 693. Gypsum. Alabaster Bay, Lake Michigan.

No. 694. Stalactitic Gypsum. Mammoth cave, Kentucky.

No. 695. Limestones of coral reefs. Bermuda.

No. 696. Onondaga Salt group. Onondaga county, N. Y.

No. 697. Clay stones. West Albany, N. Y.

No. 698. Minerals. Rutland, Vt.

No. 699. Serpentine. Hoboken, N. J.

No. 700. Miscellaneous minerals. New England (various localities).

No. 701. Miscellaneous minerals. St. Lawrence county, N. Y.

No. 702. Miscellaneous minerals. Orange county, N. Y.

No. 703. Quartz, crystals and iron ore. Herkimer county, N. Y.

No. 704. Rose Quartz and Muscovite. Acworth, N. H.

No. 705. Miscellaneous minerals. Hudson river valley, N. Y.

No. 706. Drusy Quartz and Chryoprase, Newfane, Vt.

No. 707. Miscellaneous minerals. Berkshire county, Mass.

No. 708. Chert. Spraker's Basin, N. Y.

No. 709. Flints, chalk formation. England.

No. 710. Quartz and Galenite. Southampton lead mine, Mass.

No. 711. Chalcedony. France.

No. 712. Various minerals. Essex county, N. Y.

No. 713. Cummingtonite and Black Oxide of Manganese. Cummington, Mass.

No. 714. Tourmaline. Haddam, Conn.

No. 715. Laurentian minerals. Hall's collection. Northern New York.

No. 716. Various minerals. New York city.

No. 717. Phlogopite (dark brown mica). Pope's Mills, St. Lawrence county, N. Y.

No. 718. Phlogopite (silvery mica). Edwards, St. Lawrence county, N. Y.

No. 719. Iron ore. Hawley, Mass.

No. 720. Brown Hematite. Columbia county, N. Y.

No. 721. Brown Hematite. Salisbury, Conn.

No. 722. Various minerals. Saratoga county, N. Y.

No. 821. Indian relics. Gebhard collection of 1872.

No. 822. Fossils from the Guelph formation at Elora, Ontario, from David Boyle.

No. 825. Calcite in various forms. Ball's cave specimens, principally Gebhard collection.

No. 826. Claystones and concretions. Gebhard collection. Schoharie, N. Y.

No. 835. Clinton group. Iron pyrites. Gebhard collection of 1872. Schoharie, N. Y.

No. 836. Minerals of the Simms collection. Mainly without localities.

No. 837. Indian stone implements. Dexter-Marsh collection. Connecticut river valley.

No. 838. Indian stone implements. Loudonville, Albany county, N. Y. F. E. Aspinwall, collector.

No. 845. Cretaceous Fossils. Mt. Lebanon, Syria. Henry A. Riley, collector. 1871.

No. 846. Ores and minerals. From various localities.

No. 847. Minerals of unknown or undetermined localities.

No. 877. Marcellus Shale. Cox's falls near Cherry Valley, and falls one and a half miles southeast of Cherry Valley. J. W. Hall, collector. 1877.

No. 878. Light-colored Corniferous Limestone. Corals, etc. Along railroad at Cherry Valley. J. W. Hall, collector. 1877.

No. 879. Upper Helderberg group. Corals. Thompson's lake and vicinity. J. W. Hall, collector. 1877.

No. 880. Oriskany Sandstone and Corniferous Limestone. Miscellaneous. Knox and vicinity. J. W. Hall, collector. 1877.

No. 881. Upper and Lower Helderberg groups. Corals, etc. Schoharie, N. Y. J. W. Hall, collector. 1877.

No. 882. Lower Helderberg group. Quarries near Cobleskill, N. Y. J. W. Hall, collector. 1877.

No. 883. Upper Helderberg group. Sharon and vicinity. J. W. Hall, collector. 1877.

No. 884. Upper Helderberg group. Sharon and vicinity. J. W. Hall, collector. 1877.

No. 885. Lower Helderberg group. Corals. Sharon Springs. J. W. Hall, collector. 1877.

No. 886. Railroad cut, four miles northeast of Cherry Valley. J. W. Hall, collector. 1877.

No. 887. Hamilton group. Springfield, Otsego county, N. Y. J. W. Hall, collector. 1877.

No. 888. Upper Helderberg group. Richfield Springs and vicinity. J. W. Hall, collector. 1877.

No. 889. Hamilton group. Lawyersville, two miles west of Cobleskill, N. Y. J. W. Hall, collector. 1877.

No. 890. Hamilton group. Hartwick and south of Cooperstown, N. Y. J. W. Hall, collector. 1877.

No. 891. Hamilton group. West of Port Jervis, N. Y. J. W. Hall, collector. 1877.

No. 892. Lower Helderberg group. Two miles east and south of Port Jervis, N. Y. J. W. Hall, collector. 1877.

No. 893. Lower Helderberg group. Nearpass quarry, four miles south of Port Jervis, N. Y. J. W. Hall, collector. 1887.

No. 894. Lower Helderberg group. Trilobites, Nearpass quarry, one-half mile northwest of Port Jervis, N. Y. J. W. Hall, collector. 1877.

No. 895. Hamilton group. Delphi, N. Y., and vicinity. J. W. Hall, collector. 1877.

No. 900. Minerals. Schoharie, N. Y. Presented by the Schoharie Academy, August, 1881, in return for a collection of fossils sent to the school.

The following numbers, 700–730, are repetitions of the same numbers in the preceding pages of the catalogue, but as those designate minerals only and the following are applied to fossils, very little embarrassment can arise from the oversight in making the original entries.

No. 700*. Potsdam Sandstone. St. Croix falls, Minnesota. 1865.

No. 701*. Chazy Limestone. Chazy, N. Y.

No. 710. Trenton Limestone. Bay Quinta, Canada. James Hall, collector.

No. 711. Trenton Limestone. Petrie's quarry, Little Falls, Herkimer county, N. Y. J. W. Hall, collector.

No. 712. Trenton Limestone. Harris' quarry, near Middleville, N. Y. J. W. Hall, collector.

No. 713. Trenton Limestone. Stony brook, two miles south of Middleville, N. Y. J. W. Hall, collector.

No. 714. Trenton Limestone. ? Creek near Middleville, N. Y. J. W. Hall, collector.

No. 715. Trenton Limestone. Old city. J. W. Hall, collector.

No. 716. Trenton Limestone. Old city (brook on Phillips' farm). J. W. Hall, collector.

No. 717. Trenton Limestone. West Canada creek, two miles north of Poland. J. W. Hall, collector.

No. 718. Trenton Limestone. Gravesville, two miles south of Trenton Falls, N. Y. J. W. Hall, collector.

No. 719. Trenton Limestone. Rathbun's creek, two miles north of Newport. J. W. Hall, collector.

No. 720. Hudson River group. Cincinnati, Ohio, and Madison, Indiana.

No. 721. Trenton Limestone. Smiths, White creek. J. W. Hall, collector.

No. 722. Trenton Limestone. Shed brook, two miles south of Newport, N. Y. J. W. Hall, collector.

No. 730. Niagara group. Lockport, N. Y. James Hall, old collection.

[This record will be continued in the Report of the State Geologist for 1889.]

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*The numbers 700 and 701 remain in red or crimson tickets, as in the original collection of Professor Hall.